ADDENDUM NO. 2

The Construction of
City of Bismarck Solid Waste Management Facility
Cell 1 Construction – LF 2021-001
Bismarck, North Dakota

Date of Issue: Thursday April 22, 2021

Date of Bid Opening: Wednesday April 28, 2021 @ 4:00 p.m.

NOTICE TO ALL PLANHOLDERS:

Please insert this Addendum into your copy of the project Contract Documents.

The following changes and/or additions to the Contract Documents for the project are issued by the Engineer and shall have the same force and effect as though part of the original issue.

A copy of the sign-in sheet from the pre-bid meeting as attached herein.

REVISIONS TO THE CONTRACT DOCUMENTS:

1. INSTRUCTIONS TO BIDDERS: Add the following after the last paragraph on Page 4:

As a part of the solicitation response the CONTRACTOR shall provide, as an attachment to the bid, a cost summary breakdown of the material and labor components of Bid Items relating to the geosynthetic liner materials. This cost summary breakdown applies to the following Bid Items:

- Bid Item 29 (Special Provision 11) HDPE Geomembrane Liner (60 mil)
- Bid Item 30 (Special Provision 12) Geocomposite Drainage Layer
- Bid Item 51 (Special Provision 35) Geotextile Fabric

The response should also include a summary of the anticipated number of mobilization(s) to install each of the proposed materials.

2. APPROXIMATE QUANTITIES and PROPOSAL BID FORM: The following revisions have been made to the APPROXIMATE QUANTITIES and BID PROPOSAL FORM:

- **Remove** item 1207-2.3 (Geotextile Fabric Reinforcement) and **Replace** with Special Provision 35 – Geotextile Fabric**.** This revision was necessitated based on material specification. The material quantity has been reduced to minimize waste based on available roll widths to an amount of 3,898 SQUARE YARDS. See plan revisions of Detail B on Sheet D-2.
- **Revise** item 801-4.60 (Pipe Bedding Material) to an amount of 1,770 TON.
- **Add** item 801-4.1 (6" PVC Sanitary Sewer (SS) Pipe) in the amount of 48 LINEAR FEET
- **Revise** item 901-2.5 (6" Gate Valve w/box) to an amount of 2 by EACH
- **Add** item 901-2.5 (8" Gate Valve w/Box) in the amount of 1 by EACH

Replace the Approximate Quantities Page in the Instructions to Bidders section and the Proposal Bid Form with the attached revised APPROXIMATE QUANTITIES (rev1) page and the attached revised PROPOSAL BID FORM (rev 1).

3. ATTACHMENT NO. 1: **Update** Table 4-1 under the "Calcium Carbonate Content (ASTM D304297, pH = 4.0) by removing the following text: "Acceptable Criteria <= 0.5% content by weight" from both the Sand Drainage Layer and Leachate Collection Gravel columns.

Calcium Carbonate testing will be required as a component of the project. Source testing results will not be considered a condition of material acceptance.

4. ATTACHMENT NO. 2: **Add** ATTACHMENT 2 – Factual Report – Bismarck Landfill Sand Exploration for Cell 1 (attached herein) after ATTACHMENT 1.

5. ATTACHMENT NO. 3: **Add** ATTACHMENT 3 – Compliance Testing results from previous (excavation phase) of project (attached herein) after ATTACHMENT 2.

REVISIONS TO THE SPECIFICATIONS:

1. Special Provisions - Contractors Special Requirements: **Add** the following after paragraph eight (8):

The Engineer will provide electronic surfaces files of the existing and proposed grading available to the CONTRACTOR upon request. To obtain the surface files the CONTRACTOR must submit a completed version of the attached "DISCLAIMER FOR THE USE OF ELECTRONIC MEDIA" form to Dennis McAlpine at dmcalpine@houstoneng.com

The provided files were generated and compatible with AutoCAD version 2020. Houston Engineering, Inc will not manipulate the files in any way to provide compatibility to other software platforms and/or earlier version of AutoCAD.

As a result of the current supply chain uncertainties associated with the production and availability of resin-based products the OWNER will accommodate for material price adjustments applied to resin-based products limited to HDPE Geomembrane Liner, Geocomposite Drainage Layer and Geotextile Fabric.

The CONTRACTOR or OWNER may request a price adjustment for these materials if the material price **increases or decreases** by 10% from the time of bidding to product order.

The request, along with supporting documentation and/or invoices, shall be provided within 21 days of product order. Payment for materials will be based on the unit prices bid for the project. The bid prices for these materials will be **increased or decreased by the amount above or below the 10% increase or decrease** based on the differing cost of material pricing.

2. SPECIAL PROVISION NO. 7 – Buffer Layer (CV) (P): **Remove** the second and third paragraphs under PART 3 – EXECUTION / TESTING and replace with the following:

"Construction Quality Control (CQC) – CONTRACTOR provided:

Buffer Layer materials will be tested via a Construction Quality Control (CQC) process by the Contractor at their source (source testing) for their respective required parameters using the testing procedures as defined in the CQAP provided in Attachment 1. The Buffer Layer materials shall be tested at ½ the interval as defined for the Re-Compacted Clay Barrier Layer. The Contractor will submit the required testing data to the Engineer for approval prior to acceptance of Buffer Layer material for use in the project.

Construction Quality Assurance (CQA) – OWNER provided:

The Engineer will conduct Construction Quality Assurance (CQA) testing during construction of Buffer Layer material for required parameters using the testing procedures as defined in the CQAP provided in Attachment 1. The Buffer Layer materials shall be tested at ½ the interval as defined for the Re-Compacted Clay Barrier Layer. A soils testing lab will be contracted to the Engineer or Owner to conduct the required assurance testing. The CQA program consists of:"

3. SPECIAL PROVISION NO. 8 – Re-Compacted Clay Barrier Layer (CV) (P): **Revise** the second sentence of paragraph 2 under PART 3 – EXECUTION / PLACEMENT as follows:

   "Re-Compacted Soil Barrier Layer shall be placed at 2% to 5% wet of optimum moisture content."

4. SPECIAL PROVISION NO. 15 – Leachate Riser Structure: **Add** the following after the last bullet under the MEASUREMENT AND PAYMENT section:

   - " Furnish and install DIP stand-pipe including hardware."

5. SPECIAL PROVISION NO. 35 – Geotextile Fabric: **Add** special provision (attached herein) following Special Provision 34 – Instruments.

REVISIONS TO THE PLANS:

1. Plan Sheet C-1: **Revise** the call-out denoting the "PREFERRED LOCATION OF REMOVALS/PLACEMENT" to display as "SECONDARY LOCATION OF REMOVALS/PLACEMENT". **Update** sheet to include the following note: "NOTE 1. THE OWNER HAS PROVIDED A STOCKPILE OF TOPSOIL MATERIALS FOR USE BY THE CONTRACTOR. THE TOPSOIL MATERIALS ARE STOCKPLIED IN FUTURE CELLS 3-4.

2. Plan Sheet PP-11: **Revise** call-out on sanitary sewer profile removing reference to 6" diameter piping. **Replace** call-out text as follows: "282'-0" 8" SDR 21 @ 0.6%"

3. Plan Sheet D-2: **Revise** call-out and dimensioning on Detail B denoting width of "CUSHION GEOTEXTILE CUSHION" from 16.0 feet to 15.0 feet.

All other requirements and stipulations of the plans and specifications shall remain in effect.
The receipt of this addendum shall be acknowledged in the Bidder's Proposal.

HOUSTON ENGINEERING, INC.

This document was originally issued and sealed by Dennis McAlpine, PE, North Dakota Registration Number PE-9886, on April 22, 2021, and the original documents are stored at Houston Engineering, Inc., 3712 Lockport Street, Bismarck, ND.

By: _____
Dennis McAlpine, P.E.
ND Reg. No. 9886

PRE-BID SIGN-IN SHEET

City of Bismarck Solid Waste Management Facility
Cell 1 Construction
City of Bismarck, ND
Wednesday, April 14, 2021

NAME	COMPANY/ORGANIZATION	PHONE	EMAIL
Ryan Holte	RJ Zavoral & Sons	Office (218) 773-0586 Cell (218) 230-1189	rholte@rjzavoral.com
Jeremy Rath	Running Horse LLC	Office Cell 701-421-4479	Jeremy@Runninghorsetruckings.com
Tell Fredericks	Running Horse LLC	Office Cell 701-870-0128	fredericksfarm@live.com
Richard Vorpahl	MK WEEDEN CONSTRUCTION, INC.	Office Cell 847-867-7068	rvorpahl@mkweeden.com
JAY HOLEN	STRATA CORPORATION	Office Cell 701-500-4237	JAYe HOLEN@STRATACORPORATION.COM
NATHAN KEMP	MARTIN	Office Cell 915-497-8328	nkemp@martinnd.com
JOE KESSEL	BARANKO BROS INC	Office 701-483-5868 Cell 701-290-8375	joe@baranko.com
CODY IDSO	BARANKO BROS. INC	Office 701-483-5868 Cell 701-430-0919	Codyidso@baranko.inc.com
		Office Cell	

Houston Engineering, Inc.
HEI Project No. 4489-0017

Sheet _____ of _____

PRE-BID SIGN-IN SHEET

City of Bismarck Solid Waste Management Facility
Cell 1 Construction
City of Bismarck, ND
Wednesday, April 14, 2021

NAME	COMPANY/ORGANIZATION	PHONE	EMAIL
Cody Frederick	Running Horse LLC	Office Cell 870-012 9	Cody@Runninghorsefracking.com
Joey Hendrickson	Barski Exc	Office Cell 320-393-4160	
		Office Cell	
		Office Cell	
		Office Cell	
		Office Cell	
		Office Cell	
		Office Cell	
		Office Cell	

PRE-BID SIGN-IN SHEET

City of Bismarck Solid Waste Management Facility
Cell 1 Construction
City of Bismarck, ND
Wednesday, April 14, 2021

NAME	COMPANY/ORGANIZATION	PHONE	EMAIL
Craig Griesbach	Jensen Brothers	Office Cell 701-561-1805	Craig@jensenbrothers Construction.com
James Small	mmi excavation	Office Cell 701-319-6319	jim@mmiexcavation.com
Garrett Bietz	Dan Hart Patrol Service	Office Cell 307-622-0421	bietzg@danhartpatrol.com
		Office Cell	
		Office Cell	
		Office Cell	
		Office Cell	
		Office Cell	
		Office Cell	

PRE-BID SIGN-IN SHEET

City of Bismarck Solid Waste Management Facility
Cell 1 Construction
City of Bismarck, ND
Wednesday, April 14, 2021

NAME	COMPANY/ORGANIZATION	PHONE	EMAIL
JASON RODD	EDLING ELECTRIC	Office 701-255-2831 Cell 701-426-6616	jasonrodd@edlingelectric.com
Matt Welsh	Skeels Electric	Office 701-223-5440 Cell 701-516-2609	DREW@skeelselectric.com
JOHN HONSKI	John Reffig & Electric	Office 701-845-5712 Cell 701-490-5713	JILL_LONSKI@HOTMAIL.COM
Derek Dann	NIC	Office 701-223-6695 Cell ~~701-319-7321~~	ddane@nicnd.com
Chris Roen	NIC	Office 701-223-6695 Cell 701-319-7321	croene@nicnd.com
John Fettig	NIC	Office Cell 701-319-2756	—
		Office Cell	
		Office Cell	
		Office Cell	

Houston Engineering, Inc.
HEI Project No. 4489-0017

Sheet _____ of _____

CITY OF BISMARCK SOLID WASTE UTILITY PROJECT: LF 2021-001
APPROXIMATE QUANTITES

CITY OF BISMARCK ENGINEERING DEPARTMENT
CONTRACTORS PROPOSAL
City of Bismarck Solid Waste Facility Project
LF 2021-001
(rev 1)

Bid Item No.	Tech Spec Ref#	Item Description	Unit	Quantity
1	201-2.1	Miscellaneous Removals	LS	1
2	204-3.1	Subgrade Preparation For Gravel Surface Course	SY	713
3	205-4.1	Silt Fence	LF	500
4	205-4.9	12-inch fiber rolls	LF	1,282
5	302-4.2	Class 13 Aggregate Surface	TON	998
6	801-4.60	Pipe Bedding Material	TON	1,770
7	801-4.1	6 " PVC Sanitary Sewer (SS) Pipe	LF	48
8	801-4.1	8 " PVC Sanitary Sewer (SS) Pipe	LF	286
9	802-2.19	RIPRAP Type M	TON	20
10	802-4.5	24" RCP Culvert	LF	48
11	802-4.5	12" RCP Culvert	LF	67
12	901-2.5	6" Gate valve w/box	EA	2
13	901-2.5	8" Gate valve w/box	EA	1
14	901-2.19	Insulation Boards	SY	133
15	1201-4.1	Topsoiling and Topsoil Replacement over earthen stockpiles	CY	2,315
16	1202-4.4	Class IV Seeding	SY	19,004
17	1204-4.1	Mulching	SY	19,004
18	1205-4.1	Concrete MH	EA	1
19	SP1	Mobilization and Demobilization	LS	1
20	SP2	Groundwater/Stormwater Control & Removal	MGAL	10,000
21	SP3	Watering	MGAL	100
22	SP4	Test Pit Excavation	HR	40
23	SP5	Common Excavation (CV) (P)	CY	103,952
24	SP6	Subgrade Correction (CV)	CY	2,500
25	SP7	Buffer Layer (CV) (P)	CY	16,009
26	SP8	Re-Compacted Soil Barrier Layer (CV) (P)	CY	36,617
27	SP9	Sand Drainage Layer (In-Place) (P)	CY	18,308
28	SP10	Phase Separation and Temporary Drainage Berms (CV)	CY	4,063
29	SP11	HDPE Geomembrane Liner (60 mil.)	SY	53,943
30	SP12	Geocomposite Drainage Layer	SY	25,183
31	SP13	Groundwater Underdrain (Perforated) Piping	LF	1,715
32	SP13	Groundwater Underdrain (Solid) Piping	LF	132
33	SP13	Groundwater Underdrain Discharge Piping	LF	364
34	SP14	Groundwater Underdrain - Coarse Aggregate	TON	700
35	SP15	Leachate Riser Structure	LS	1

36	SP16	Leachate Collection Trench (Perforated) Piping	LF	923
37	SP16	Leachate Collection Sideslope Cleanout (Solid) Piping	LF	1,108
38	SP16	Leachate Sump Riser (Perforated) Piping	LF	30
39	SP16	Leachate Sump Sideslope Riser (Solid) Piping	LF	470
40	SP17	Leachate Collection Trench - Drainage Aggregate	TON	557
41	SP17	Leachate Collection Trench - Coarse Filter Aggregate	TON	882
42	SP18	Bollards	EA	6
43	SP19	Rock Ditch Check	CY	85
44	SP20	Future Gas Well Drainage Enhancement	CY	375
45	SP21	Wood Chip Placement (LV)	CY	8,060
46	SP22, SP32, SP33, SP34	Leachate Collection/Underdrain Pumps & Ancillary Equipment	LS	1
47	SP26, SP27, SP28, SP31	Ancillary Equipment - Wiring Devices, Panelboards, Transformers, Unit Heaters	LS	1
48	SP23, SP24, SP25, SP29, SP 30	Electrical/Labor - Conduit & Conductors and General	LS	1
49	SP25	Electrical - Street Lighting	LS	1
50	SP23	Electrical - Capitol Electric Distribution	LS	1
51	SP35	Geotextile Fabric	SY	3,898

CITY OF BISMARCK ENGINEERING DEPARTMENT
CONTRACTORS PROPOSAL
City of Bismarck Solid Waste Facility Project
LF 2021-001
(rev 1)

Bid Item No.	Tech Spec Ref#	Item Description	Unit	Quantity	Unit Price	Extension
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47	SP26, SP27, SP28, SP31	Ancillary Equipment - Wiring Devices, Panelboards, Transformers, Unit Heaters	LS	1		
48	SP23, SP24, SP25, SP29, SP 30	Electrical/Labor - Conduit & Conductors and General	LS	1		
49	SP25	Electrical - Street Lighting	LS	1		
50	SP23	Electrical - Capitol Electric Distribution	LS	1		
51	SP35	Geotextile Fabric	SY	3,898		
		Project LF 2021-001 Total Bid Amount				

ATTACHMENT
NO. 2
FACTUAL REPORT – BISMARCK LANDFILL SAND EXPLORATION FOR CELL 1

Factual Report

Bismarck Landfill Sand Exploration for Cell 1
2111 N 52nd Street
Bismarck, North Dakota

Prepared for

Houston Engineering, Inc.

March 11, 2019

Project B1900033

Braun Intertec Corporation

BRAUN INTERTEC
The Science You Build On.

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
1502 Grumman Lane
Bismarck, ND 58504

Phone: 701.255.7180
Fax: 701.255.7208
Web: braunintertec.com

March 11, 2019

Project B1900033

Mr. Sherwin Wanner
Houston Engineering, Inc.
1401 21st Avenue North
Fargo, ND 58102

Re: Factual Report
Bismarck Landfill Sand Exploration for Cell 1
2111 N 52nd Street
Bismarck, North Dakota

Dear Mr. Wanner:

We are pleased to present this Factual Report for the exploration of the sand layer in the area of the proposed Cell 1 of the Bismarck Landfill. The new cell will be located south of the existing landfill.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Emily Erickson at EErickson@braunintertec.com.

Sincerely,

BRAUN INTERTEC CORPORATION

Emily Erickson

Emily J. Erickson, EIT
Staff Engineer

Charles W. (Wes) Dickhut, PE
Principal/Principal Engineer

Table of Contents

Description **Page**

Appendix

A. Introduction

A.1. Project Description

This Factual Report addresses the subsurface conditions encountered at Cell 1 at the landfill, located in Bismarck, North Dakota. The project will include the excavation of the area with the addition of an artificial liner prior to use as a landfill. The primary concern for these explorations was the extent of a permeable sand layer expected, and groundwater conditions that should be expected during excavation. Table 1 provides project details.

Table 1. Project Description

Aspect	Description
Anticipated top of landfill (feet)	1777 to 1780
Anticipated liner elevation (feet)	1721 to 1713

The figure below shows an illustration of the proposed site layout.

Figure 1. Site Layout

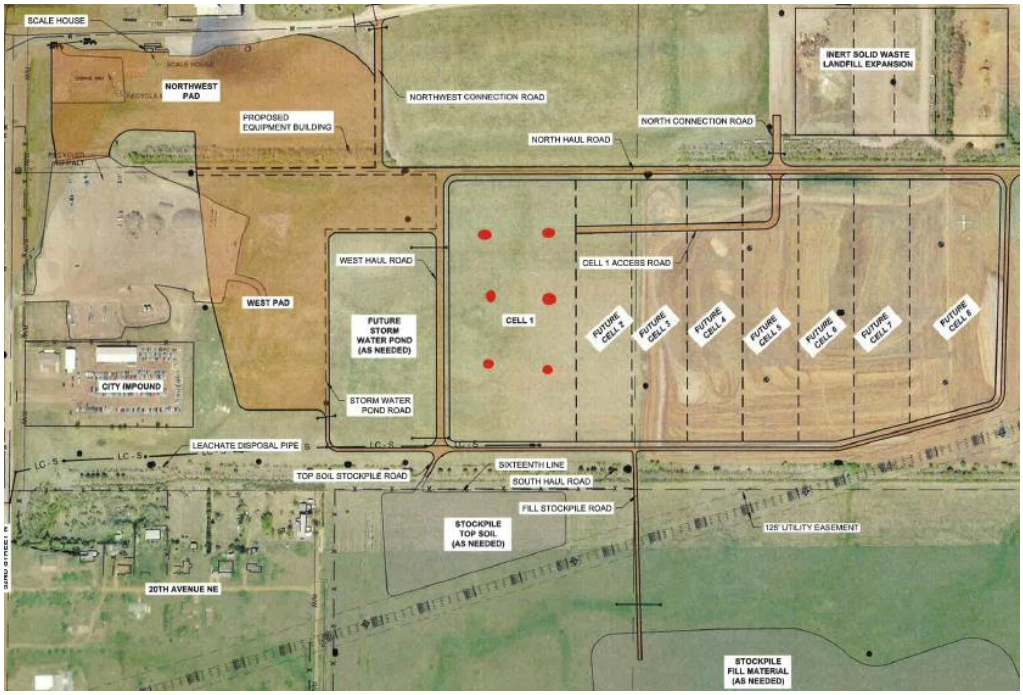

Figure provided by Houston Engineering dated October 3, 2018.

A.2. Site Conditions and History

Currently, the site exists as an open field with a ground level between elevations 1,771 and 1,790 feet. Generally, the site is downward sloping from northeast to southwest.

A.3. Purpose

The purpose of our geotechnical evaluation was to characterize subsurface geologic conditions at selected exploration locations.

A.4. Background Information and Reference Documents

We reviewed the following information:

- *Expansion Area Cell 1 – Cell 1 Plan View,* prepared by Houston Engineering and dated October 3, 2018.
- *Expansion Area Cell 1 – Cell 1 Section B*, prepared by Houston Engineering and dated October 3, 2018.
- Communications with Sherwin Wanner of Houston Engineering regarding scope of work.
- *Web Soil Survey*, http://websoilsurvey.nrcs.usda.gov/. United States Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS).
- *Land Form and Geologic Map of Burleigh County, North Dakota*, prepared by the North Dakota Geological Survey, Bulletin 42, Plate1, not dated, used to evaluate the surficial geology on the project site.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.5. Scope of Services

We performed our scope of services for the project in accordance with our Proposal QTB086174 to Houston Engineering, dated November 2, 2018, and authorized on January 2, 2019. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Staking and clearing the exploration location of underground utilities. Houston Engineering selected and staked the exploration locations. Houston Engineering also provided boring location elevations for our use. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.
- Performing 6 standard penetration test (SPT) borings, denoted as ST-01 to ST-06, to nominal depths of 51 feet below grade across the site.
- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.
- Discussion involving extent and composition of sand layer in the area of the proposed cell.

At your request, we converted Boring ST-04 to a temporary piezometer and performed a grain-size distribution test on a bulk sample of the sand obtained during drilling.

Our scope of services did not include environmental services or testing, and we did not train the personnel performing this evaluation to provide environmental services or testing. We can provide these services or testing at your request.

B. Results

B.1. Geologic Overview

In review of the Geologic Map referenced previously, the site appears to lie in an area generally underlain with glacial deposits. The glacial deposits consist of glacial outwash composed of sand. Underlying these glacial deposits is the Tertiary-aged Cannonball Formation which consists of

decomposed sandstone, siltstone and claystone bedrock. The surficial soils were formed from weathering of the glacial deposits.

We based the geologic origins used in this report on the soil types, and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

B.2. Boring Results

Table 2 provides a summary of the soil boring results, in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheets in the Appendix include definitions of abbreviations used in Table 2.

Table 2. Subsurface Profile Summary*

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Topsoil	SC	N/A	▪ Dark Brown with trace roots. ▪ Thickness at boring locations generally ½ foot. ▪ Frozen, but moist when thawed.
Glacial deposits	SM	12 to 32 BPF	▪ Brown. ▪ Trace roots and iron staining. ▪ Variable amounts of gravel present. ▪ Dry.
Cannonball Formation – Bedrock	Claystone, Sandstone	14 to 88 BPF	▪ Top of bedrock varied from elevation 1767.7 (ST-03) to 1790.3 (ST-04). ▪ Decomposed claystone texturally classified as Fat Clay (CH) with interbedded siltstone. ▪ Decomposed sandstone texturally classified as Poorly Graded Sand with Silt (SP-SM) and Silty Sand (SM).

*Abbreviations defined in the attached Descriptive Terminology sheets.

Table 3 shows top and bottom elevation of sandstone layer encountered in our borings.

Table 3. Sandstone Layer Elevations

Aspect	Description
Approximate elevation top of sand layer (feet)	1765 to 1752
Approximate elevation bottom of sand layer (feet)	1744 to 1732

B.3. Groundwater

Table 4 summarizes the depths where we observed groundwater; the attached Log of Boring sheets in the Appendix also include this information and additional details.

Table 4. Groundwater Summary

Location	Surface Elevation	Measured Depth to Groundwater (ft)	Corresponding Groundwater Elevation (ft)
ST-01	1771.6	29.5	1742 1/2
ST-02	1781.1	34.5	1747
ST-03	1773.7	27	1747
ST-04	1790.7	39.5	1751 1/2
ST-05	1774.2	27	1747 ½
ST-06	1781.4	32	1749 ½

Note: groundwater observations were rounded up to the nearest ½ foot.

A piezometer was installed in Boring ST-04 by inserting a 1-inch-diameter PVC pipe to the bottom of the borings. Screen with an opening of 0.010 inches was inserted between elevations of 1750 and 1740 feet. Filter sand was inserted from the bottom of the boring to an elevation of 1735 feet. A 2-ft-thick layer of bentonite chips was inserted on top of the sand, and then the borehole was backfilled with auger cuttings. On February 25, the water level was measured to be 1753 feet. The soil borings indicate a layered soil profile that is conducive for encountering perched water conditions in the sandstone. Project planning should expect groundwater will fluctuate in relation to seasonal and annual fluctuations.

B.4. Boring Backfill

The borings were backfilled with bentonite chips from the bottom of the boring to 5 feet above the sand layer. The remainder of each borehole was backfilled with auger cuttings.

B.5. Laboratory Test Results

We performed 16 moisture contents (per ASTM D2216), 2 Atterberg limits (per ASTM D4318), and 3 percent passing the No. 200 sieve tests (per ASTM D1140) and 1 Sieve Analysis with 200 wash (per ASTM C 136 and C 117) on representative samples obtained from the borings.

B.5.a. Moisture Contents

We performed moisture content (MC) tests (per ASTM D2216) on selected samples to aid in our classifications and estimations of the material's engineering properties. Table 5 below presents the results of our moisture content tests.

Table 5. Moisture Content Results.

Material Type	Moisture Content Range (%)	Above/Below Estimated Optimum Moisture
Fat Clay (CH)	18 to 32	At or Above
Sandstone (SP-SM)	1 to 25	Below to Above
Claystone (CH)	22 to 26	At or Above

B.5.b. Atterberg Limit Tests

We performed Atterberg Limits tests (per ASTM D4318) on select samples. The results of these tests were used to estimate the plasticity of the clay and are shown on Table 6 below.

Table 6. Atterberg Limit Results

Sample Location	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification
ST-04, 5 feet	63	21	42	Fat Clay (CH)
ST-04, 15 feet	84	26	58	Fat Clay (CH)

B.5.c. Percent Passing the #200 Sieve Test

We performed tests to evaluate the percent of particles passing the #200 sieve (P200, per ASTM D1140) to confirm our visual classification. The result of these tests indicated that the sandstone soils tested had silt contents of 11 to 14 percent. The Log of Boring sheets list the results of the P200 test in the "Tests or Notes" column.

B.5.d. Sieve Analysis with #200 Wash

We performed a sieve analysis with a #200 wash (per ASTM C 136 and C117) to determine grain size distribution of a representative sample of the granular material. The result of this test can be found on the Grain Size Distribution Curve in the attachments. We performed this test from collecting a bag sample of boring ST-04 from 30 to 40 feet, which corresponds to the sandstone layer we investigated. The resulting sample was composed of 34 percent fine sand, and less than 1 percent silt-sized material.

C. Procedures

C.1. Penetration Test Borings

We drilled the penetration test borings with a truck-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5-foot intervals in general accordance to ASTM D1586. The boring logs show the actual sample intervals and corresponding depths. We also collected bulk samples of auger cuttings at selected locations for laboratory testing.

C.2. Exploration Logs

C.2.a. Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials, and present the results of penetration resistance and other tests performed. The logs also present the results of laboratory tests performed on penetration test samples, and groundwater measurements. The Appendix also includes a Fence Diagram intended to provide a summarized cross-sectional view of the soil profile across the site.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

C.2.b. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

C.3. Material Classification and Testing

C.3.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

C.3.b. Laboratory Testing

The exploration logs in the Appendix note most of the results of the laboratory tests performed on geologic material samples. The remaining laboratory test results follow the exploration logs. We performed the tests in general accordance with ASTM procedures.

C.4. Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, as noted on the boring logs. One boring was converted to a temporary piezometer.

D. Qualifications

D.1. Variations in Subsurface Conditions

D.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

D.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

D.2. Continuity of Professional Responsibility

D.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

D.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

D.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

D.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

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DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

N

150' 0 300'

SCALE: 1" = 300'

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Minneapolis, MN 55438
952.995.2000
braunintertec.com

Project No: B1900033

Drawing No: B1900033

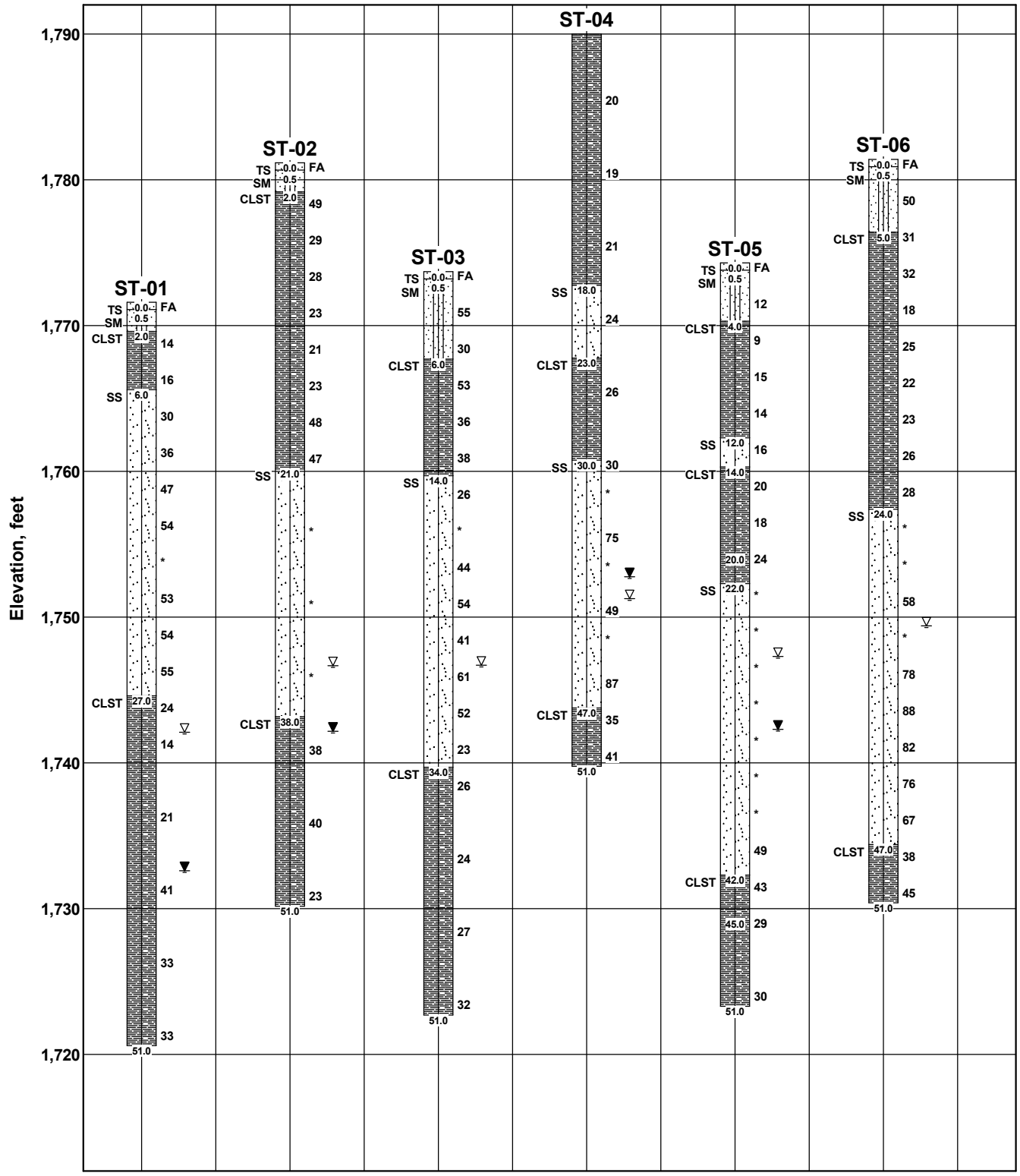
Drawn By:	LAO
Date Drawn:	2/25/19
Checked By:	EE
Last Modified:	2/25/19

Geotechnical Evaluation

Bismarck Landfill Sand Exploration

Bismarck, North Dakota

Soil Boring Location Sketch



Fence Diagram

(Horizontal distance not to scale)

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-01**

LOCATION: 46.830178, -100.701763, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/10/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1771.6	0.0						
1771.1	0.5	TS / SM	CLAYEY SAND, trace roots and Gravel, dark brown, frozen (moist when thawed). (Topsoil)	FA			Frost encountered to 2 feet.
1769.6	2.0	CLST	SILTY SAND, trace roots, little Gravel, calcification, and iron staining, brown, frozen (dry when thawed). (Glacial Outwash)	14			Boring elevations provided by Houston Engineering from surveying onsite.
1765.6	6.0		CANNONBALL FORMATION, CLAYSTONE, trace iron staining, interbedded Siltstone, brown, dry, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	16			
		SS	CANNONBALL FORMATION, SANDSTONE, fine-grained, brown to gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Poorly Graded Sand with Silt (SP-SM)".	30			
				36			
				47		1	P200=12%
				54			
				*			*50/2".
				53			
				54			
				55			An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. A solid triangle indicates the groundwater level in the boring on the date indicated. Groundwater levels fluctuate.
1744.6	27.0						
		CLST	CANNONBALL FORMATION, CLAYSTONE, trace iron staining, interbedded with Siltstone, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	24	▽		
				14			

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-01 (cont.)**
LOCATION: 46.830178, -100.701763, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/10/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1739.6	32.0		CANNONBALL FORMATION, CLAYSTONE, trace iron staining, interbedded with Siltstone, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)". *(continued)*	21	▼		
				41			
				33			
1720.6	51.0			33			
			END OF BORING. Water observed at a depth of 29 1/2 feet while drilling. Water observed at a depth of 39 feet with 49 1/2 feet of hollow-stem auger in the ground. Water not observed to cave-in depth of 24 feet immediately after withdrawal of auger. Boring then backfilled with bentonite chips to 1 foot below the surface. Auger cuttings used to backfill remainder of the boring.				

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LOG OF BORING

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Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-02**

LOCATION: 46.830202, -100.699970, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/20/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1781.2	0.0						
1780.7	0.5	TS	CLAYEY SAND, trace roots, dark brown, frozen (moist when thawed).	FA			Frost encountered to 2 feet.
		SM	(Topsoil)				
1779.2	2.0	CLST	SILTY SAND, trace roots and calcification, brown, frozen (moist when thawed). (Glacial Outwash)	49			
			CANNONBALL FORMATION, CLAYSTONE, trace iron staining, interbedded Siltstone, brown, dry, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	29			
				28			
				23		23	
				21			
				23		20	
				48			
1760.2	21.0			47			
		SS	CANNONBALL FORMATION, SANDSTONE, fine-grained, brown to gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Poorly Graded Sand with Silt (SP-SM)".	*			*50/5".
				*			*50/4".

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-02 (cont.)**
LOCATION: 46.830202, -100.699970, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/20/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1749.2	32.0		CANNONBALL FORMATION, SANDSTONE, fine-grained, brown to gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Poorly Graded Sand with Silt (SP-SM)". *(continued)*	*	▽		*50/3".
1743.2	38.0	CLST	CANNONBALL FORMATION, CLAYSTONE, interbedded with Siltstone, brown and gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	38	▼	26	
				40			
1730.2	51.0			23			
			END OF BORING. Water observed at a depth of 34 1/2 feet while drilling. Water observed at a depth of 39 feet with a cave-in depth of 34 feet immediately after withdrawal of auger. Boring then backfilled with bentonite chips to 16 feet below the surface. Auger cuttings used to backfill remainder of the boring.				

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-03**

LOCATION: 46.829357, -100.701680, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/14/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1773.7	0.0						
1773.2	0.5	TS SM	CLAYEY SAND, trace roots, dark brown, frozen (moist when thawed). (Topsoil)	FA			Frost encountered to 2 feet.
			SILTY SAND, trace roots and calcification, brown, frozen (dry when thawed), very dense to medium dense. (Glacial Outwash)	55			
				30			
1767.7	6.0	CLST	CANNONBALL FORMATION, CLAYSTONE, trace iron staining, interbedded with Siltstone, brown, dry, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	53		22	
				36			
				38		25	
1759.7	14.0	SS	CANNONBALL FORMATION, SANDSTONE, fine-grained, brown and gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Poorly Graded Sand with Silt (SP-SM)".	26			
				*			*50/5".
				44			
				54		17	P200=11%
				41			
					▽		
				61			
				52			

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Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-03 (cont.)**
LOCATION: 46.829357, -100.701680, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/14/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1741.7	32.0			23			
1739.7	34.0	CLST	CANNONBALL FORMATION, CLAYSTONE, interbedded with Siltstone, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	26		23	
				24			
				27		24	
1722.7	51.0			32			
			END OF BORING. Water observed at a depth of 27 feet while drilling. Water not observed to cave-in depth of 49 1/2 feet immediately after withdrawal of auger. Boring then backfilled with bentonite chips to 9 feet below the surface. Auger cuttings used to backfill remainder of the boring.				

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-04**

LOCATION: 46.829376, -100.700082, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/20/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1790.8	0.0						
1790.3	0.5	TS CLST	CLAYEY SAND, trace roots, dark brown, frozen (moist when thawed). (Topsoil)	FA			Frost encountered to 4 feet.
			CANNONBALL FORMATION, CLAYSTONE, trace iron staining, interbedded Siltstone, brown, frozen (moist when thawed) to moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".				
				20		18	LL=63, PL=21, PI=42
				19			
				21		32	LL=84, PL=26, PI=58
1772.8	18.0						
		SS	CANNONBALL FORMATION, SANDSTONE, fine-grained, interbedded Claystone, brown, moist, decomposed, very soft, sample retrieved as non-cemented "Silty Sand (SM)".	24			
1767.8	23.0						
		CLST	CANNONBALL FORMATION, CLAYSTONE, interbedded Siltstone, trace mineralization and iron staining, brown, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	26		25	
1760.8	30.0						
		SS		30			Gradation performed from bag sample taken from 30 to 40 feet.

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-04 (cont.)**
LOCATION: 46.829376, -100.700082, See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/20/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1758.8	32.0		CANNONBALL FORMATION, SANDSTONE, fine-grained, brown to gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Silty Sand (SM)". *(continued)*	*			*50/5".
				75			
				*			*50/2".
				49			
				*			*50/3".
				87			
1743.8	47.0						
		CLST	CANNONBALL FORMATION, CLAYSTONE, interbedded Siltstone, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	35			
1739.8	51.0			41			
			END OF BORING. Water observed at a depth of 39 1/2 feet while drilling. A piezometer with a screen depth interval of 41 to 51 feet was set in the borehole. On February 25 2019 water level was observed at 38 feet in piezometer.				

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-05**

LOCATION: 46.828495, -100.701712 See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/10/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1774.3	0.0						
1773.8	0.5	TS SM	CLAYEY SAND, trace Gravel and roots, dark brown, frozen (moist when thawed). (Topsoil)	FA			Frost encountered to 2 feet.
1770.3	4.0		SILTY SAND, trace roots and calcification, brown, frozen (dry when thawed) to dry, medium dense. (Glacial Outwash)	12			
		CLST	CANNONBALL FORMATION, CLAYSTONE, trace iron staining and mineralization, interbedded Siltstone, brown, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	9		23	
				15			
				14		29	
1762.3	12.0						
1760.3	14.0	SS	CANNONBALL FORMATION, SANDSTONE, fine-grained, interbedded Claystone, trace iron staining, brown, moist, decomposed, very soft, sample retrieved as non-cemented "Silty Sand (SM)".	16			
		CLST	CANNONBALL FORMATION, CLAYSTONE, trace iron stianing and mineralization, interbedded with Siltstone, brown, moist, dense, very soft, hand deformed sample classified as "Fat Clay (CH)".	20			
				18			
			-with Sandstone seams at 20 feet.	24			
1752.3	22.0						
		SS	CANNONBALL FORMATION, SANDSTONE, fine-grained, trace iron staining, gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Poorly Graded Sand with Silt (SP-SM)".	*			*50/3".
				*			*50/6".
					▽		
				*			*50/6".
				*			*50/6".
					▼		

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-05 (cont.)**
LOCATION: 46.828495, -100.701712 See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/10/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1742.3	32.0		CANNONBALL FORMATION, SANDSTONE, fine-grained, trace iron staining, gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Poorly Graded Sand with Silt (SP-SM)". *(continued)*	*			*50/5".
				*			*50/5".
				*			*50/2".
				49			
1732.3	42.0	CLST	CANNONBALL FORMATION, CLAYSTONE, interbedded with Siltstone, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	43			
			-with Sandstone seam at 45 feet.	29			
				30			
1723.3	51.0		END OF BORING.				

Water observed at a depth of 27 feet while drilling.

Water observed at a depth of 32 feet with 49 1/2 feet of hollow-stem auger in the ground.

Water not observed to cave-in depth of 21 feet immediately after withdrawal of auger.

Boring then backfilled with bentonite chips to 17 feet below the surface. Auger cuttings used to backfill remainder of the boring.

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LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-06**

LOCATION: 46.828523, -100.700297 See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/18/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1781.4	0.0						
1780.9	0.5	TS	CLAYEY SAND, trace roots, dark brown, frozen (moist when thawed).	FA			Frost encountered to 2 feet.
		SM	(Topsoil)				
			SILTY SAND, trace calcification and roots, brown, frozen (dry when thawed) to moist, dense. (Glacial Outwash)	50			
1776.4	5.0	CLST	CANNONBALL FORMATION, CLAYSTONE, trace iron staining, interbedded Siltstone, brown, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	31			
				32			
				18		25	
				25			
				22		27	
				23			
				26		25	
				28			
1757.4	24.0	SS	CANNONBALL FORMATION, SANDSTONE, fine-grained, brown and gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Silty Sand (SM)".	*			*50/5".
				*			*50/5".
				58	▽		

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2019\00033.GPJ BRAUN_V8_CURRENT.GDT 3/11/19 14:40

BRAUN INTERTEC

LOG OF BORING

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota

BORING: **ST-06 (cont.)**
LOCATION: 46.828523, -100.700297 See sketch

DRILLER: A.Horner | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/18/19** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1749.4	32.0		CANNONBALL FORMATION, SANDSTONE, fine-grained, brown and gray, moist to wet, decomposed, very soft, sample retrieved as non-cemented "Silty Sand (SM)". *(continued)*	*			*50/5".
				78			
				88		25	P200=14%
				82			
				76			
				67			
1734.4	47.0						
		CLST	CANNONBALL FORMATION, CLAYSTONE, interbedded with Siltstone, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	38		22	
1730.4	51.0			45			
			END OF BORING. Water observed at a depth of 32 feet while drilling. Water not observed to cave-in depth of 49 1/2 feet immediately after withdrawal of auger. Boring then backfilled with bentonite chips to 19 feet below the surface. Auger cuttings used to backfill remainder of the boring.				

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2019\00033.GPJ BRAUN_V8_CURRENT.GDT 3/11/19 14:40

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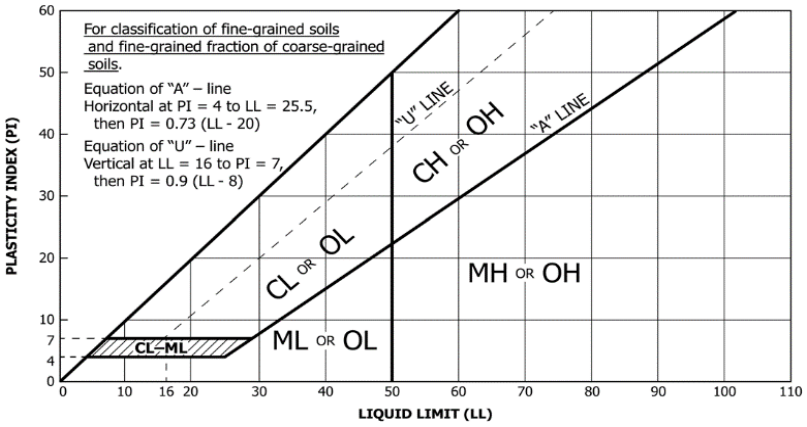
The Science You Build On.

Descriptive Terminology of Soil

Based on Standards ASTM D 2487-11/2488-09a
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3^D$	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3^D$	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[I]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OL	Organic clay[K L M N] / Organic silt[K L M O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OH	Organic clay[K L M P] / Organic silt[K L M Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line



Particle Size Identification

Boulders..... over 12"
Cobbles..... 3" to 12"
Gravel
  Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)
  Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
  Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)
  Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)
  Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt..... No. 200 (0.075 mm) to .005 mm
Clay..... < .005 mm

Relative Proportions[L, M]

trace..... 0 to 5%
little..... 6 to 14%
with..... ≥ 15%

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 1"

Apparent Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF
Loose ..... 5 to 10 BPF
Medium dense..... 11 to 30 BPF
Dense..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 1/4 tsf
Soft	2 to 4 BPF	1/4 to 1/2 tsf
Medium	5 to 8 BPF	1/2 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6 inches into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6-inch increments, and added to get BPF.

Partial Penetration: If the sampler cannot be driven the full 12 inches beyond the initial 6-inch set, the number of blows for that partial penetration is shown as "No./X" (i.e., 50/2"). If the sampler cannot be advanced beyond the initial 6-inch set, the depth of penetration will be recorded in the Notes column as "No. to set X" (i.e., 50 to set 4").

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

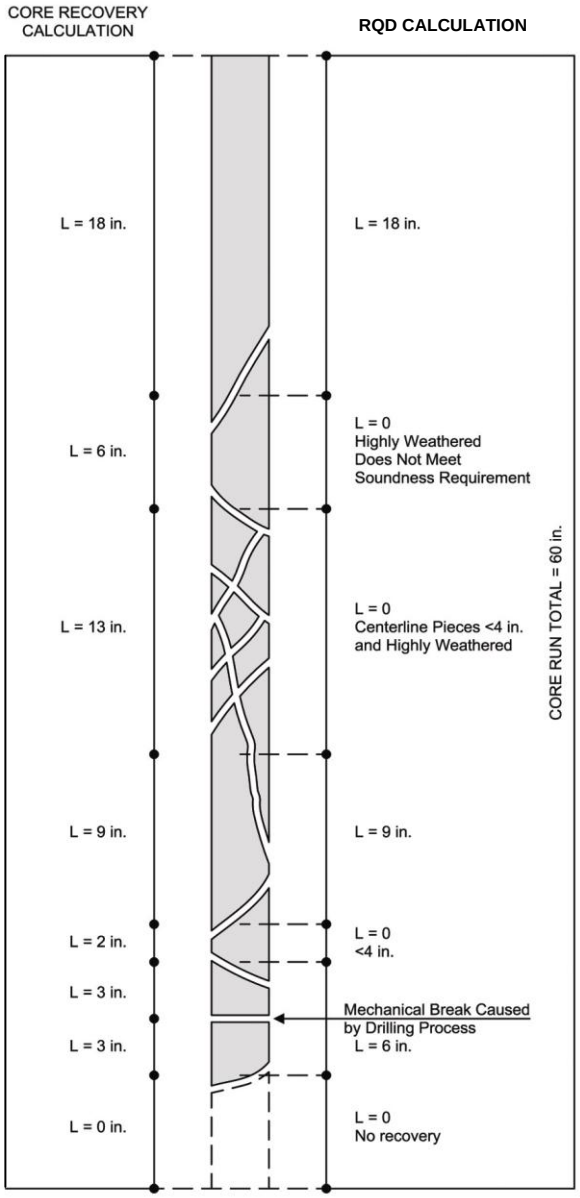
WL: WL indicates the water level measured by the drillers either while drilling or following drilling.

Laboratory Tests

DD	Dry Density, pcf	**OC**	Organic content, %	**PL**	Plastic limit, %
WD	Wet Density, pcf	**q_p**	Pocket penetrometer strength	**LL**	Liquid limit, %
P200	% Passing #200 sieve	**MC**	Moisture conent, %	**PI**	Plasticity Index, %

Descriptive Terminology of Rock

Based on U.S. Army Corps of Engineers EM 1110-1-2908



Example Calculations

Core Recovery, CR = $\frac{\text{Total length of rock recovered}}{\text{Total core run length}}$

Example:CR = $\frac{(18 + 6 + 13 + 9 + 2 + 3 + 3)}{(60)}$

CR = 90%

RQD = $\frac{\text{Sum of sound pieces 4 inches or larger}}{\text{Total core run length}}$

RQD Percent	Rock Quality
< 25	very poor
25 < 50	poor
50 < 75	fair
75 < 90	good
90 < 100	excellent

Example: RQD = $\frac{(18 + 9 + 6)}{(60)}$

RQD = 55%

Weathering

Unweathered: No evidence of chemical or mechanical alteration.

Slightly weathered: Slight discoloration on surface, slight alteration along discontinuities, less than 10% of rock volume altered.

Moderately Weathered: Discoloration evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering halos evident, 10% to 50% of the rock altered.

Highly Weathered: Entire mass discolored, alteration pervading nearly all of the rock, with some pockets of slightly weathered rock noticeable, some mineral leached away.

Decomposed: Rock reduced to a soil consistency with relict rock texture, generally molded and crumbled by hand.

Hardness

Very soft:	Can be deformed by hand
Soft:	Can be scratched with a fingernail
Moderately hard:	Can be scratched easily with a knife
Hard:	Can be scratched with difficulty with a knife
Very hard:	Cannot be scratched with a knife

Texture

Sedimentary Rocks:	*Grain Size*
Coarse grained	2 – 5 mm
Medium grained	0.4 – 2 mm
Fine grained	0.1 – 0.4 mm
Very fine grained	< 0.1 mm

Igneous and Metamorphic Rocks:	
Coarse grained	5 mm
Medium grained	1 – 5 mm
Fine grained	0.1 – 1 mm
Aphanitic	< 0.1 mm

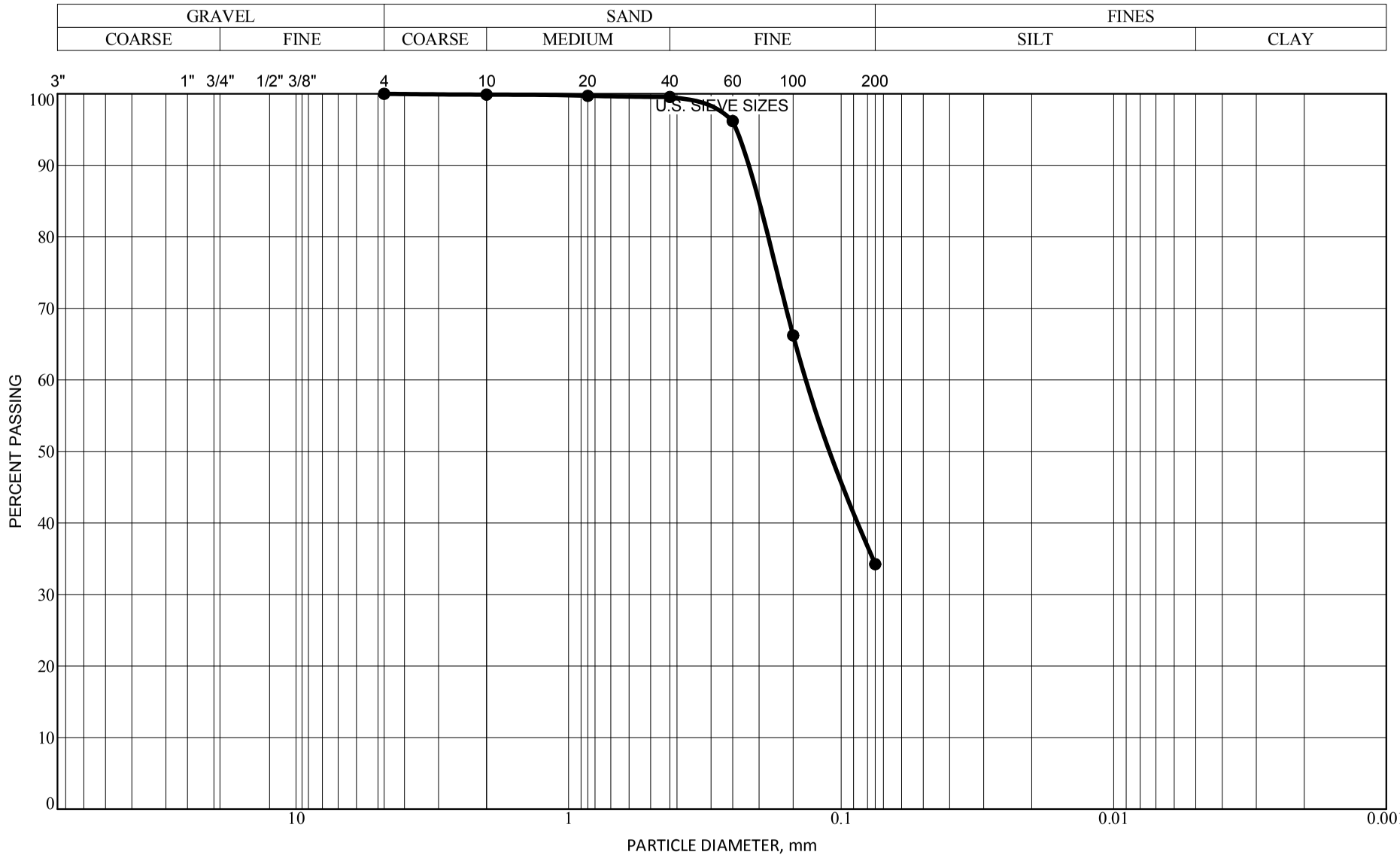
Thickness of Bedding

Massive:	3 ft. thick or greater
Thick bedded:	1 to 3 ft. thick
Medium bedded:	4 in. to 1 ft. thick
Thin bedded:	4 in. thick or less

Degree of Fracturing (Jointing)

Unfractured:	Fracture spacing 6 ft. of more
Slightly fractured:	Fracture spacing 2 to 6 ft.
Moderately fractured:	Fracture spacing 8 in. to 2 ft.
Highly fractured:	Fracture spacing 2 in. to 8 in.
Intensely fractured:	Fracture spacing 2 in. or less

GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN INTERTEC

Braun Project B1900033
Geotechnical Evaluation
Bismarck Landfill Sand Exploration
2111 N 52nd St
Bismarck, North Dakota
BORING: ST-04 DEPTH: 35.0'

GRAVEL	0.0%
SAND	65.8%
FINES	34.2%
D60=0.131	Cu=
D30=	Cc=
D10=	

CLASSIFICATION:
Silty Sand (SM)

GS ASTM N:\GINT\PROJECTS\AX PROJECTS\2019\00033.GPJ BRAUN_V8_CURRENT.GDT 2/27/19 10:39

ATTACHMENT
NO. 3
COMPLIANCE TESTING
RESULTS FROM THE 2020
EXCAVATION PHASE - CITY
PROJECT # LF 2020-001

NTI™
NORTHERN TECHNOLOGIES, LLC

Bismarck
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Bismarck, North Dakota 58504
P: 701.425.5791 F: 701.232.1864
www.NTIgeo.com

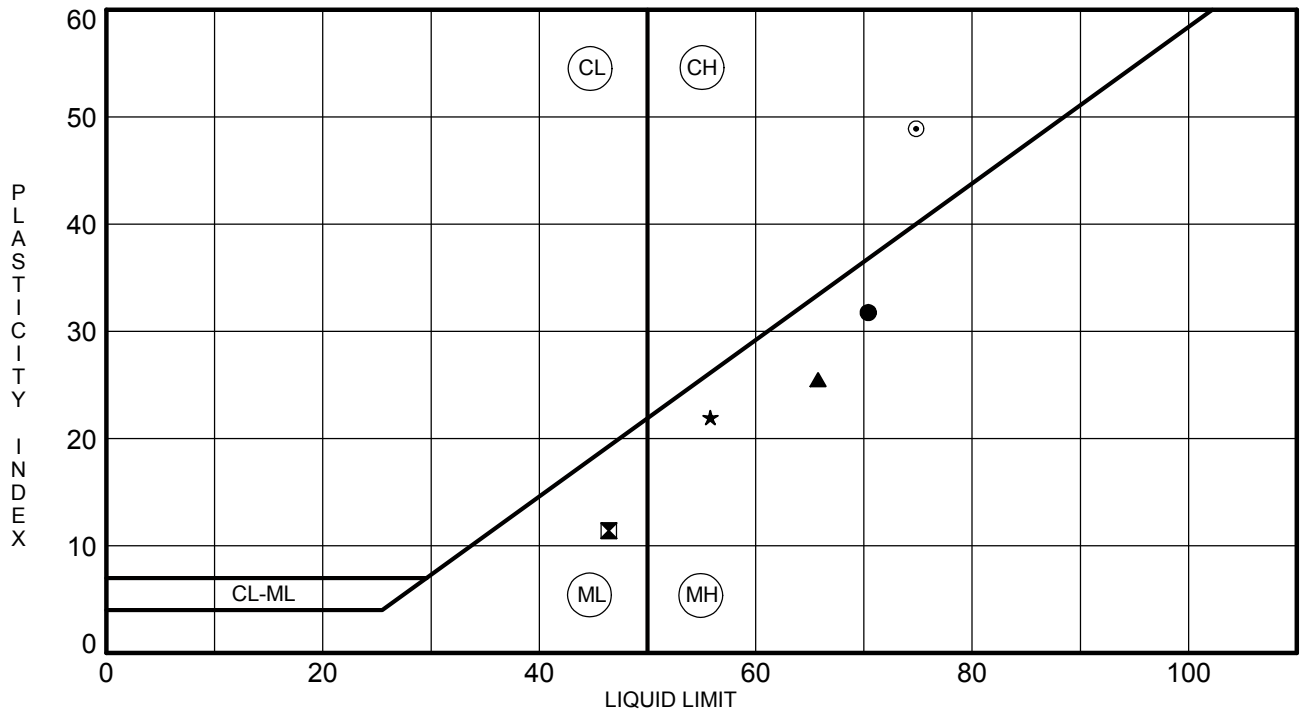
ATTERBERG LIMITS' RESULTS

ASTM D4318

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Data

	SAMPLE #	LL	PL	PI	Fines	Classification
●	P-1	70	39	31	54	SANDY FAT CLAY, BROWN
⊠	P-2	46	35	11	52	SANDY LEAN CLAY, LIGHT BROWN TO GRAY
▲	P-3	66	40	26	65	SANDY FAT CLAY, LIGHT BROWN TO GRAY
★	P-4	56	34	22	66	SANDY FAT CLAY, BROWN
⊙	P-5	75	26	49	57	SANDY FAT CLAY, LIGHT BROWN TO GRAY



Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/23/20)

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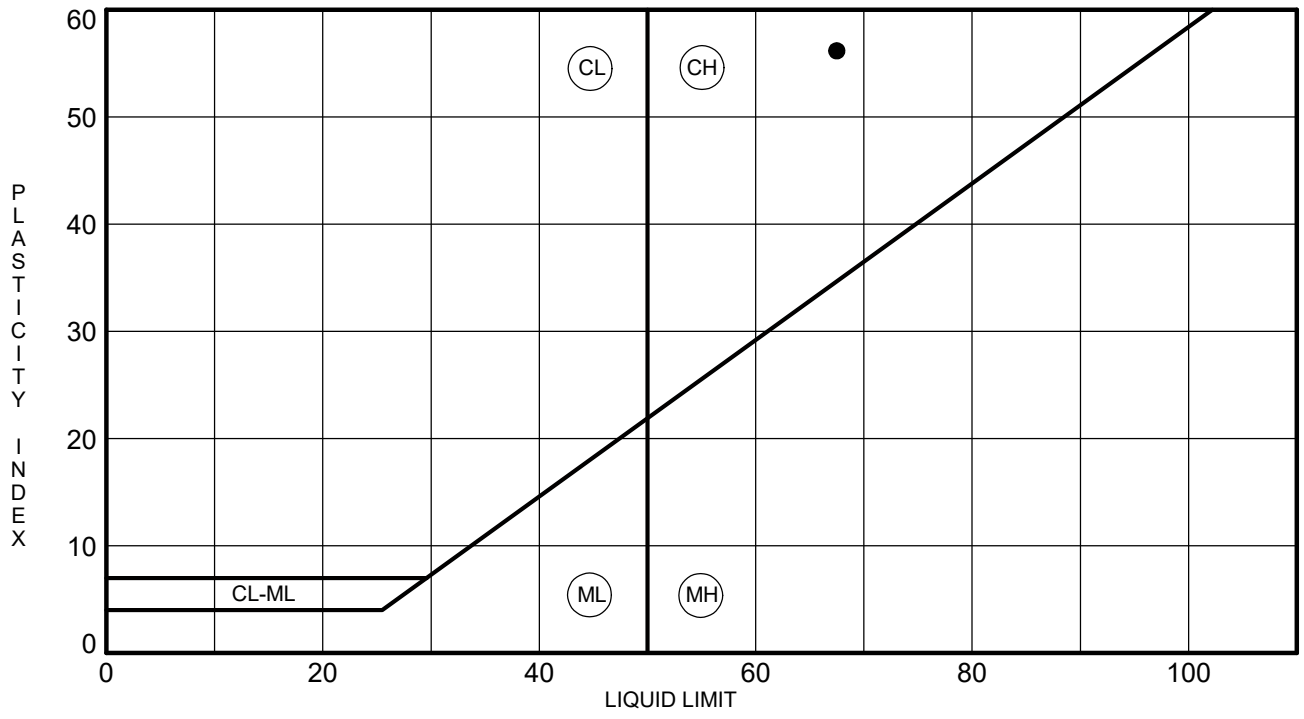
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Data

	SAMPLE #	LL	PL	PI	Fines	Classification
●	P-7	67	11	56		SANDY LEAN CLAY, GRAY



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Submitted by,
Northern Technologies, LLC

Tyler Hall
(6/3/20)

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DENSITY TEST OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
Attention:	**Zach Bopp, PM**	Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
1	4/1/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 51+00	90		-3	3	B	1780.59	P-1	127.5	19.7	106.5	104.6	19.9	101.8	Pass	Pass
2	4/1/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 55+00	90		-3	3	B	1790.37	P-2	112.8	21.7	92.7	100.4	20.9	92.3	Pass	Pass
3	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 79+00, 10' RIGHT	90		-3	3	B	2	P-2	117.4	22.9	95.5	100.4	20.9	95.1	Pass	Pass
4	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 84+00, 10' LEFT	90		-3	3	B	2	P-2	120.0	21.8	98.5	100.4	20.9	98.1	Pass	Pass
5	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 10+00, 10' LEFT	90		-3	3	B	2	P-2	116.5	21.4	96.0	100.4	20.9	95.6	Pass	Pass
6	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 15+50, CENTER LINE	90		-3	3	B	2	P-2	116.6	23.9	94.1	100.4	20.9	93.7	Pass	Pass
7	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 72+50, CENTER LINE	90		-3	3	B	2	P-2	117.5	19.0	98.7	100.4	20.9	98.3	Pass	Pass
8	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 68+50, 20' RIGHT	90		-3	3	B	4	P-2	118.3	21.1	97.7	100.4	20.9	97.3	Pass	Pass
9	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 65+00, 20' LEFT	90		-3	3	B	4	P-2	121.9	23.7	98.5	100.4	20.9	98.1	Pass	Pass
10	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 58+00, 10' LEFT	90		-3	3	B	3	P-2	112.5	23.6	91.0	100.4	20.9	90.6	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/10/20)

* TEST ELEVATION
A = Depth From Existing Ground Surface
B = Depth From Project Datum
C = Depth From U.S.G.S. Datum

Test results shown above are limited to the given location, elevation, and date.

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Attention:	**Zach Bopp, PM**	Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND

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			Min	Max	Min	Max										Density	Moisture
11	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 17+50, 15' RIGHT	90		-3	3	B	2	P-2	122.5	22.7	99.8	100.4	20.9	99.4	Pass	Pass

Comments:

Cc:

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1	4/1/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 51+00	90		-3	3	B	1780.59	P-1	127.5	19.7	106.5	104.6	19.9	101.8	Pass	Pass
2	4/1/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 55+00	90		-3	3	B	1790.37	P-2	112.8	21.7	92.7	100.4	20.9	92.3	Pass	Pass
3	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 79+00, 10' RIGHT	90		-3	3	B	2	P-2	117.4	22.9	95.5	100.4	20.9	95.1	Pass	Pass
4	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 84+00, 10' LEFT	90		-3	3	B	2	P-2	120.0	21.8	98.5	100.4	20.9	98.1	Pass	Pass
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7	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 72+50, CENTER LINE	90		-3	3	B	2	P-2	117.5	19.0	98.7	100.4	20.9	98.3	Pass	Pass
8	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 68+50, 20' RIGHT	90		-3	3	B	4	P-2	118.3	21.1	97.7	100.4	20.9	97.3	Pass	Pass
9	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 65+00, 20' LEFT	90		-3	3	B	4	P-2	121.9	23.7	98.5	100.4	20.9	98.1	Pass	Pass
10	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 58+00, 10' LEFT	90		-3	3	B	3	P-2	112.5	23.6	91.0	100.4	20.9	90.6	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/10/20)

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DENSITY TEST OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
Attention:	**Zach Bopp, PM**	Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
11	4/6/2020	MASS GRADING, CELL #1. HAUL ROAD, STA 17+50, 15' RIGHT	90		-3	3	B	2	P-2	122.5	22.7	99.8	100.4	20.9	99.4	Pass	Pass

Comments:

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Attention:	**Zach Bopp, PM**	Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
12	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 73+00, 10' LEFT	90		-3	3	B	4	P-2	119.2	21.8	97.9	100.4	20.9	97.5	Pass	Pass
13	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 70+00, 15' RIGHT	90		-3	3	B	6	P-2	122.1	22.8	99.4	100.4	20.9	99.0	Pass	Pass
14	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 66+00, CENTER LINE	90		-3	3	B	6	P-2	119.4	23.0	97.1	100.4	20.9	96.7	Pass	Pass
15	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 61+00, 5' RIGHT	90		-3	3	B	6	P-2	113.5	21.4	93.5	100.4	20.9	93.1	Pass	Pass
16	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 55+00, 20' RIGHT	90		-3	3	B	4	P-2	121.6	22.3	99.4	100.4	20.9	99.0	Pass	Pass
17	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 48+00, 15' RIGHT	90		-3	3	B	4	P-1	121.8	18.2	103.0	104.6	19.9	98.5	Pass	Pass
18	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 79+00, 20' LEFT	90		-3	3	B	4	P-2	116.5	21.0	96.3	100.4	20.9	95.9	Pass	Pass
19	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 84+00, 15' LEFT	90		-3	3	B	4	P-2	121.6	20.7	100.7	100.4	20.9	100.3	Pass	Pass
20	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 11+00, 10' LEFT	90		-3	3	B	4	P-2	119.3	22.1	97.7	100.4	20.9	97.3	Pass	Pass
21	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 16+00, 20' LEFT	90		-3	3	B	4	P-2	118.4	23.7	95.7	100.4	20.9	95.3	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/10/20)

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DENSITY TEST OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
Attention:	**Zach Bopp, PM**	Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
12	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 73+00, 10' LEFT	90		-3	3	B	4	P-2	119.2	21.8	97.9	100.4	20.9	97.5	Pass	Pass
13	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 70+00, 15' RIGHT	90		-3	3	B	6	P-2	122.1	22.8	99.4	100.4	20.9	99.0	Pass	Pass
14	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 66+00, CENTER LINE	90		-3	3	B	6	P-2	119.4	23.0	97.1	100.4	20.9	96.7	Pass	Pass
15	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 61+00, 5' RIGHT	90		-3	3	B	6	P-2	113.5	21.4	93.5	100.4	20.9	93.1	Pass	Pass
16	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 55+00, 20' RIGHT	90		-3	3	B	4	P-2	121.6	22.3	99.4	100.4	20.9	99.0	Pass	Pass
17	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 48+00, 15' RIGHT	90		-3	3	B	4	P-1	121.8	18.2	103.0	104.6	19.9	98.5	Pass	Pass
18	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 79+00, 20' LEFT	90		-3	3	B	4	P-2	116.5	21.0	96.3	100.4	20.9	95.9	Pass	Pass
19	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 84+00, 15' LEFT	90		-3	3	B	4	P-2	121.6	20.7	100.7	100.4	20.9	100.3	Pass	Pass
20	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 11+00, 10' LEFT	90		-3	3	B	4	P-2	119.3	22.1	97.7	100.4	20.9	97.3	Pass	Pass
21	4/7/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 16+00, 20' LEFT	90		-3	3	B	4	P-2	118.4	23.7	95.7	100.4	20.9	95.3	Pass	Pass

Comments:

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Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/10/20)

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		Project Number:	20.BIS09947.000
Attention:	**Zach Bopp, PM**	Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
22	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 10+00, CENTER LINE	90		-3	3	B	6	P-2	119.2	22.7	97.1	100.4	20.9	96.7	Pass	Pass
23	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 16+00, 10' LEFT	90		-3	3	B	6	P-2	118.6	20.7	98.3	100.4	20.9	97.9	Pass	Pass
24	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 72+00, 10' RIGHT	90		-3	3	B	6	P-2	120.7	22.2	98.8	100.4	20.9	98.4	Pass	Pass
25	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 68+00 15' RIGHT	90		-3	3	B	8	P-2	115.9	23.8	93.6	100.4	20.9	93.2	Pass	Pass
26	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 65+00, CENTER LINE	90		-3	3	B	8	P-2	119.4	21.5	98.3	100.4	20.9	97.9	Pass	Pass
27	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 61+00, 10' RIGHT	90		-3	3	B	8	P-1	123.9	18.1	104.9	104.6	19.9	100.3	Pass	Pass
28	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 53+00, CENTER LINE	90		-3	3	B	6	P-1	124.3	19.1	104.4	104.6	19.9	99.8	Pass	Pass
29	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 46+00, 10' RIGHT	90		-3	3	B	6	P-2	119.3	22.1	97.7	100.4	20.9	97.3	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/9/20)

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DENSITY TEST OF SOIL

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		Project Number:	20.BIS09947.000
Attention:	**Zach Bopp, PM**	Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
22	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 10+00, CENTER LINE	90		-3	3	B	6	P-2	119.2	22.7	97.1	100.4	20.9	96.7	Pass	Pass
23	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 16+00, 10' LEFT	90		-3	3	B	6	P-2	118.6	20.7	98.3	100.4	20.9	97.9	Pass	Pass
24	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 72+00, 10' RIGHT	90		-3	3	B	6	P-2	120.7	22.2	98.8	100.4	20.9	98.4	Pass	Pass
25	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 68+00 15' RIGHT	90		-3	3	B	8	P-2	115.9	23.8	93.6	100.4	20.9	93.2	Pass	Pass
26	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 65+00, CENTER LINE	90		-3	3	B	8	P-2	119.4	21.5	98.3	100.4	20.9	97.9	Pass	Pass
27	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 61+00, 10' RIGHT	90		-3	3	B	8	P-1	123.9	18.1	104.9	104.6	19.9	100.3	Pass	Pass
28	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 53+00, CENTER LINE	90		-3	3	B	6	P-1	124.3	19.1	104.4	104.6	19.9	99.8	Pass	Pass
29	4/8/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 46+00, 10' RIGHT	90		-3	3	B	6	P-2	119.3	22.1	97.7	100.4	20.9	97.3	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/9/20)

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Attention:	**Zach Bopp, PM**	Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
30	4/14/2020	MASS GRADING, CELL #1, HAUL RAOD; STATION 96+00, CENTER LINE	90		-3	3	B	4	P-2	122.0	23.1	99.1	100.4	20.9	98.7	Pass	Pass
31	4/14/2020	MASS GRADING, CELL #1, HAUL RAOD; STATION 93+00, LEFT	90		-3	3	B	8	P-1	123.5	21.6	101.6	104.6	19.9	97.1	Pass	Pass
32	4/14/2020	MASS GRADING, CELL #1, HAUL RAOD; STATION 92+50, RIGHT	90		-3	3	B	6	P-2	117.2	23.5	94.9	100.4	20.9	94.5	Pass	Pass
33	4/14/2020	MASS GRADING, CELL #1, HAUL RAOD; STATION 91+00, CENTERLINE	90		-3	3	B	2	P-2	113.5	17.9	96.3	100.4	20.9	95.9	Pass	Pass
34	4/14/2020	MASS GRADING, CELL #1, HAUL RAOD; STATION 73+00, CENTERLINE	90		-3	3	B	@	P-2	119.1	19.5	99.7	100.4	20.9	99.3	Pass	Pass
35	4/14/2020	MASS GRADING, CELL #1, HAUL RAOD; STATION 67+00, LEFT	90		-3	3	B	@	P-2	112.5	18.1	95.3	100.4	20.9	94.9	Pass	Pass
36	4/14/2020	MASS GRADING, STORM WATER POND BOTTOM; EAST END	90		-3	3	B	@	P-2	111.8	21.8	91.8	100.4	20.9	91.4	Pass	Pass
37	4/14/2020	MASS GRADING, STORM WATER POND BOTTOM; SOUTH SIDE	90		-3	3	B	2	P-2	117.7	18.6	99.2	100.4	20.9	98.8	Pass	Pass
38	4/14/2020	MASS GRADING, STORM WATER POND BOTTOM; NORTH SIDE	90		-3	3	B	2	P-2	118.2	18.3	99.9	100.4	20.9	99.5	Pass	Pass
39	4/14/2020	MASS GRADING, CELL #1, HAUL ROAD; STATION 5+00, CENTERLINE	90		-3	3	B	4	P-1	122.7	20.2	102.1	104.6	19.9	97.6	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/21/20)

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		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
40	4/14/2020	MASS GRADING, CELL #1, HAUL RAOD; STATION 2+00, LEFT	90		-3	3	B	2	P-1	122.8	20.9	101.6	104.6	19.9	97.1	Pass	Pass

Comments:

Cc:

Submitted by,
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Tyler Hall
(4/21/20)

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		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
41	4/15/2020	MASS GRADING, CELL #1, STORM WATER POND; NORTH SIDE	90		-3	3	B	4	P-2	113.3	18.0	96.0	100.4	20.9	95.6	Pass	Pass
42	4/15/2020	MASS GRADING, CELL #1, STORM WATER POND; WEST END, BOTTOM	90		-3	3	B	@	P-2	113.9	20.4	94.6	100.4	20.9	94.2	Pass	Pass
43	4/15/2020	MASS GRADING, CELL #1, STORM WATER POND; SOUTH SIDE	90		-3	3	B	4	P-1	121.8	16.9	104.2	104.6	19.9	99.6	Pass	Pass
44	4/15/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 6+00, CENTERLINE	90		-3	3	B	6	P-1	122.5	17.1	104.6	104.6	19.9	100.0	Pass	Pass
45	4/15/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 12+00, LEFT	90		-3	3	B	8	P-1	113.1	19.1	95.0	104.6	19.9	90.8	Pass	Pass
46	4/17/2020	MASS GRADING, CELL #1, STORM WATER POND; NORTH EMBANKMENT, EAST END	90		-3	3	B	8	P-2	113.4	18.3	95.9	100.4	20.9	95.5	Pass	Pass
47	4/17/2020	MASS GRADING, CELL #1, STORM WATER POND; NORTH EMBANKMENT, WEST END	90		-3	3	B	6	P-2	110.9	19.5	92.8	100.4	20.9	92.4	Pass	Pass
48	4/17/2020	MASS GRADING, CELL #1, STORM WATER POND; SOUTH EMBANKMENT, EAST END	90		-3	3	B	8	P-1	119.1	17.5	101.4	104.6	19.9	96.9	Pass	Pass
49	4/17/2020	MASS GRADING, CELL #1, STORM WATER POND; SOUTH EMBANKMENT, WEST END	90		-3	3	B	6	P-2	118.2	18.2	100.0	100.4	20.9	99.6	Pass	Pass
50	4/17/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 43+00, CENTERLINE	90		-3	3	B	@	P-2	114.2	21.9	93.7	100.4	20.9	93.3	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/22/20)

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			Min	Max	Min	Max										Density	Moisture
51	4/17/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 106+00, CENTERLINE	90		-3	3	B	3	P-2	110.1	18.2	93.1	100.4	20.9	92.7	Pass	Pass
52	4/17/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 110+50, LEFT	90		-3	3	B	6	P-2	110.3	19.1	92.6	100.4	20.9	92.2	Pass	Pass
53	4/17/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 111+50, LEFT	90		-3	3	B	8	P-2	111.4	19.7	93.1	100.4	20.9	92.7	Pass	Pass
54	4/17/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 51+00, RIGHT	90		-3	3	B	@	P-2	116.2	19.6	97.2	100.4	20.9	96.8	Pass	Pass
55	4/17/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 16+00, RIGHT	90		-3	3	B	@	P-2	113.3	18.2	95.9	100.4	20.9	95.5	Pass	Pass
56	4/17/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 2+00, CENTERLINE	90		-3	3	B	@	P-2	119.6	23.2	97.1	100.4	20.9	96.7	Pass	Pass
57	4/20/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 83+00	90		-3	3	B	@	P-1	124.8	19.7	104.3	104.6	19.9	99.7	Pass	Pass
58	4/20/2020	MASS GRADING, CELL #1, HAUL ROAD; STA 78+00	90		-3	3	B	@	P-1	118.4	17.6	100.7	104.6	19.9	96.3	Pass	Pass
59	4/20/2020	STORM WATER POND; SOUTH EMBANKMENT, CENTER	90		-3	3	B	10	P-1	123.0	18.6	103.7	104.6	19.9	99.1	Pass	Pass
60	4/20/2020	STORM WATER POND; NORTH EMBANKMENT, CENTER	90		-3	3	B	@	P-2	111.8	18.1	94.7	100.4	20.9	94.3	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/22/20)

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		Project Number:	20.BIS09947.000
Attention:	**Zach Bopp, PM**	Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
61	4/23/2020	STORM SEWER BACKFILL; STATION 18+70	90		-3	3	B	3	P-2	113.4	18.9	95.4	100.4	20.9	95.0	Pass	Pass
62	4/23/2020	STORM SEWER BACKFILL; STATION 15+50	90		-3	3	B	3	P-2	113.9	19.4	95.4	100.4	20.9	95.0	Pass	Pass
63	4/23/2020	STORM SEWER BACKFILL; STATION 14+00	90		-3	3	B	3	P-2	114.6	17.9	97.2	100.4	20.9	96.8	Pass	Pass
64	4/23/2020	STORM SEWER BACKFILL; 40' WEST OF STORM POND OUTLET STRUCTURE	90		-3	3	B	3	P-1	120.2	17.7	102.1	104.6	19.9	97.6	Pass	Pass
65	4/23/2020	STORM SEWER BACKFILL; STATION 17+00	90		-3	3	B	6	P-1	120.6	17.0	103.1	104.6	19.9	98.6	Pass	Pass
66	4/23/2020	STORM SEWER BACKFILL; STATION 16+00	90		-3	3	B	6	P-1	117.1	17.1	100.0	104.6	19.9	95.6	Pass	Pass
67	4/23/2020	STORM SEWER BACKFILL; STATION 14+00	90		-3	3	B	6	P-1	117.3	16.9	100.3	104.6	19.9	95.9	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/24/20)

* TEST ELEVATION
A = Depth From Existing Ground Surface
B = Depth From Project Datum
C = Depth From U.S.G.S. Datum

Test results shown above are limited to the given location, elevation, and date.

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DENSITY TEST OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
Attention:	**Zach Bopp, PM**	Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND

Test No.	Test Date	Test Location	Compaction Criteria		Moisture Criteria		Test Elevation*		Proctor Mark	Moist Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)	Percent Compaction	Requirements	
			Min	Max	Min	Max										Density	Moisture
68	4/29/2020	STORM SEWER BACKFILL; SOUTH DIKE	90		-3	3	B	@	P-2	111.1	18.0	94.2	100.4	20.9	93.8	Pass	Pass
69	4/29/2020	STORM SEWER BACKFILL; 20' EAST OF STORM POND OUTLET STRUCTURE	90		-3	3	B	-2	P-2	112.4	17.9	95.3	100.4	20.9	94.9	Pass	Pass
70	4/29/2020	STORM SEWER BACKFILL; STA 12+85	90		-3	3	B	3	P-2	110.4	19.0	92.8	100.4	20.9	92.4	Pass	Pass
71	4/29/2020	STORM SEWER BACKFILL; STA 11+60	90		-3	3	B	3	P-6	105.4	7.7	97.9	101.7	9.2	96.3	Pass	Pass
72	4/29/2020	STORM SEWER BACKFILL; STA 11+20	90		-3	3	B	3	P-6	112.2	11.4	100.7	101.7	9.2	99.0	Pass	Pass
73	4/29/2020	STORM SEWER BACKFILL; STA 1+00	90		-3	3	B	4	P-1	121.0	20.9	100.1	104.6	19.9	95.7	Pass	Pass
74	5/6/2020	STORM SEWER BACKFILL; STA 10+50	90		-3	3	B	4	P-6	112.4	29.5	86.8	101.7	9.2	85.3	Fail	Fail
75	5/6/2020	STORM SEWER BACKFILL; STA 10+70	90		-3	3	B	6	P-6	111.1	12.2	99.0	101.7	9.2	97.3	Pass	Pass
76	5/6/2020	STORM SEWER BACKFILL; STA 8+00	90		-3	3	B	8	P-6	105.5	7.3	98.3	101.7	9.2	96.7	Pass	Pass
77	5/6/2020	STORM SEWER BACKFILL; STA 4+50	90		-3	3	B	6	P-2	118.1	17.9	100.2	100.4	20.9	99.8	Pass	Pass

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(5/11/20)

* TEST ELEVATION
A = Depth From Existing Ground Surface
B = Depth From Project Datum
C = Depth From U.S.G.S. Datum

Test results shown above are limited to the given location, elevation, and date.

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GRAIN SIZE DISTRIBUTION

ASTM C136 & D422

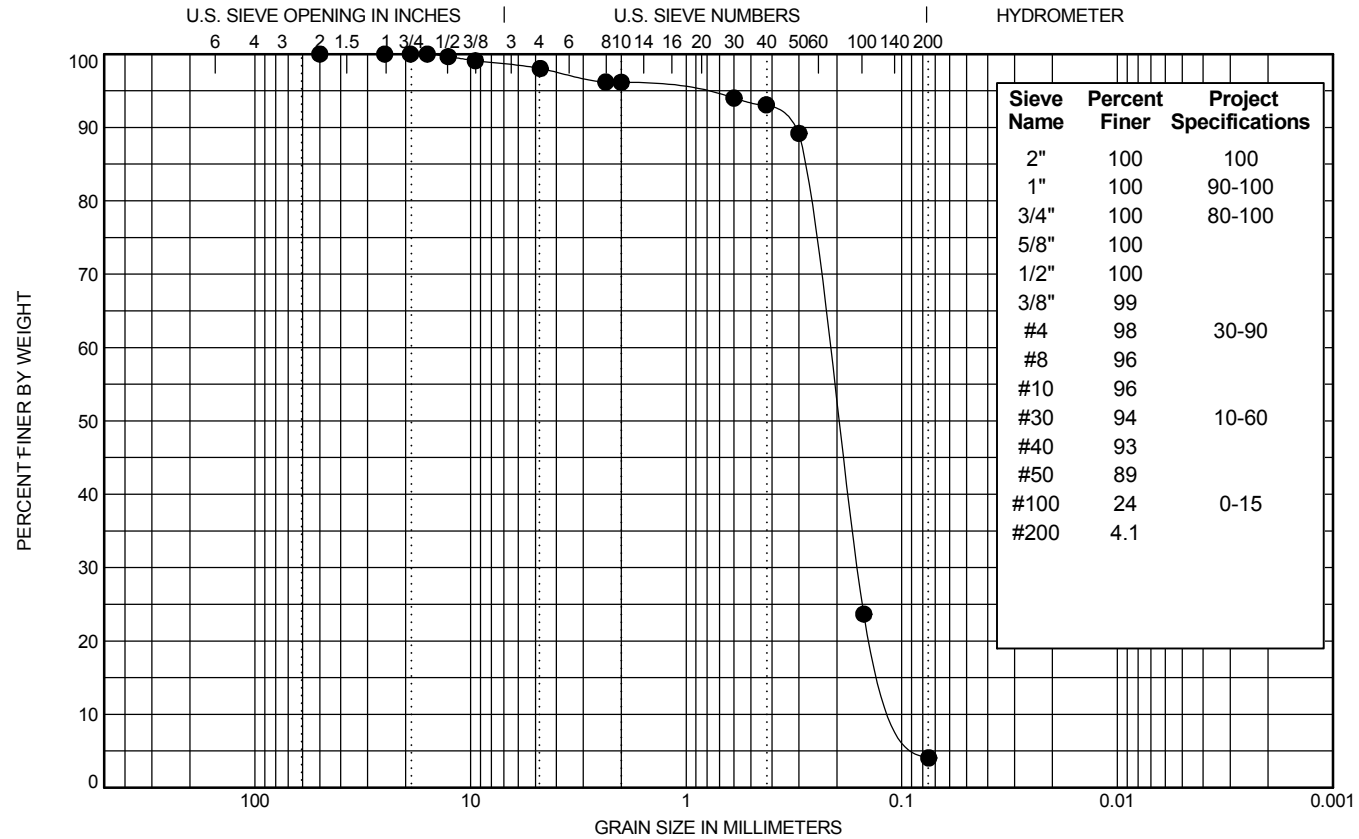
Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

Sample Number:	1	Date Sampled:	4/15/2020
Project Specifications:	BISMARCK 801-2.8 BEDDING	Sampled By:	NTI
Aggregate Type:	SAND, FINE GRAINED		
Location Sampled:	EXISTING ON SITE MATERIAL FOR BEDDING (AS RECIEVED MOISTURE CONTENT = 7.8%)		

Sample Data

Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
1.26	2.38	50	0.22	0.16	0.093	2.0	94.0	4.1	



Sieve Name	Percent Finer	Project Specifications
2"	100	100
1"	100	90-100
3/4"	100	80-100
5/8"	100	
1/2"	100	
3/8"	99	
#4	98	30-90
#8	96	
#10	96	
#30	94	10-60
#40	93	
#50	89	
#100	24	0-15
#200	4.1	

Comments: SAMPLE DID NOT MEET PROJECT SPECIFICATIONS ON THE FOLLOWING SIEVES: #4, #30, AND #100

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(5/1/20)

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GRAIN SIZE DISTRIBUTION

ASTM C136 & D422

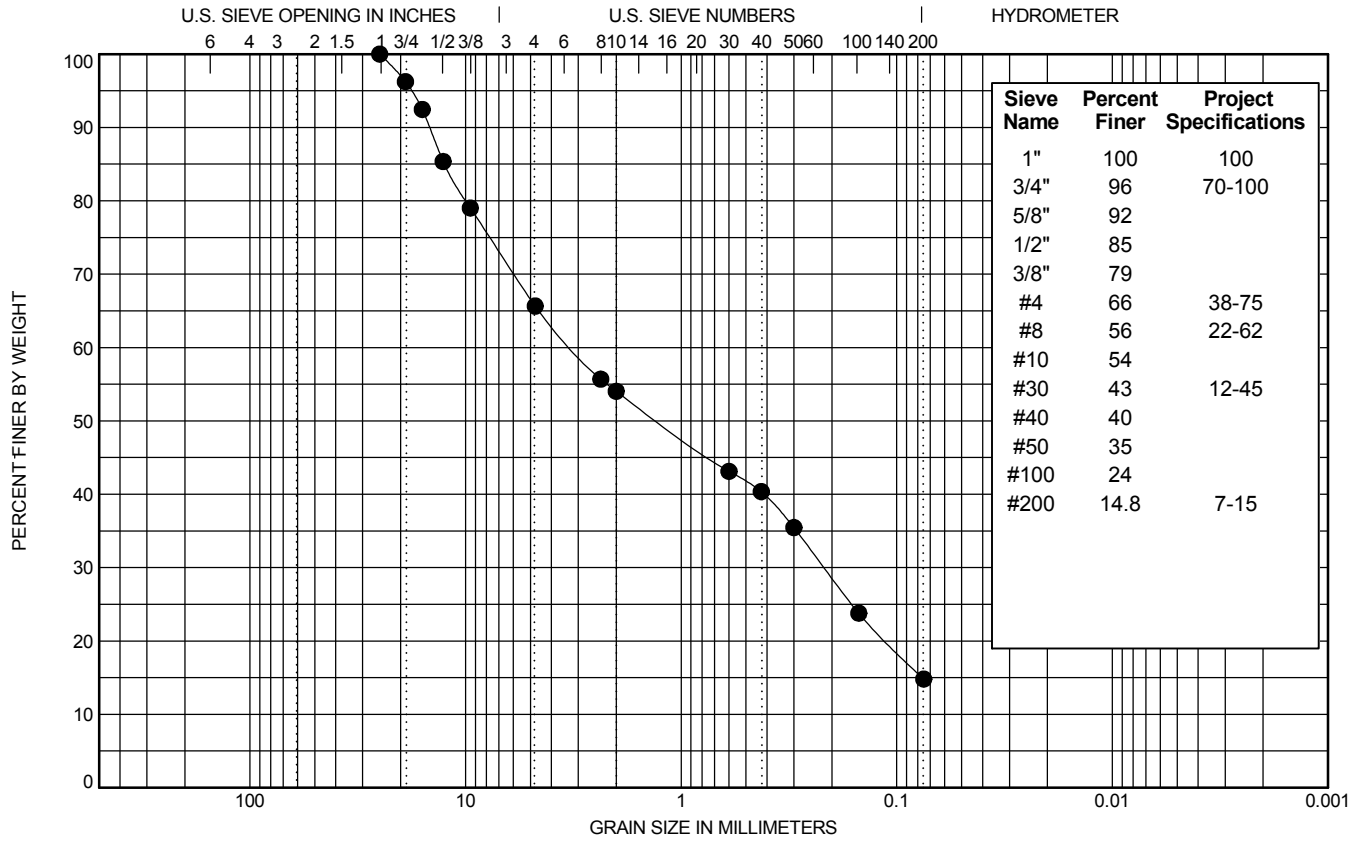
Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

Sample Number:	2	Date Sampled:	5/21/2020
Project Specifications:	CLASS #13	Sampled By:	NTI
Aggregate Type:	CLASS #13		
Location Sampled:	ND DOT CLASS 13 FROM SOURCE - KNIFE RIVER		

Sample Data

Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
		25	3.195	0.217		34.3	50.8	14.8	



Sieve Name	Percent Finer	Project Specifications
1"	100	100
3/4"	96	70-100
5/8"	92	
1/2"	85	
3/8"	79	
#4	66	38-75
#8	56	22-62
#10	54	
#30	43	12-45
#40	40	
#50	35	
#100	24	
#200	14.8	7-15

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(5/22/20)

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GRAIN SIZE DISTRIBUTION

ASTM C136 & D422

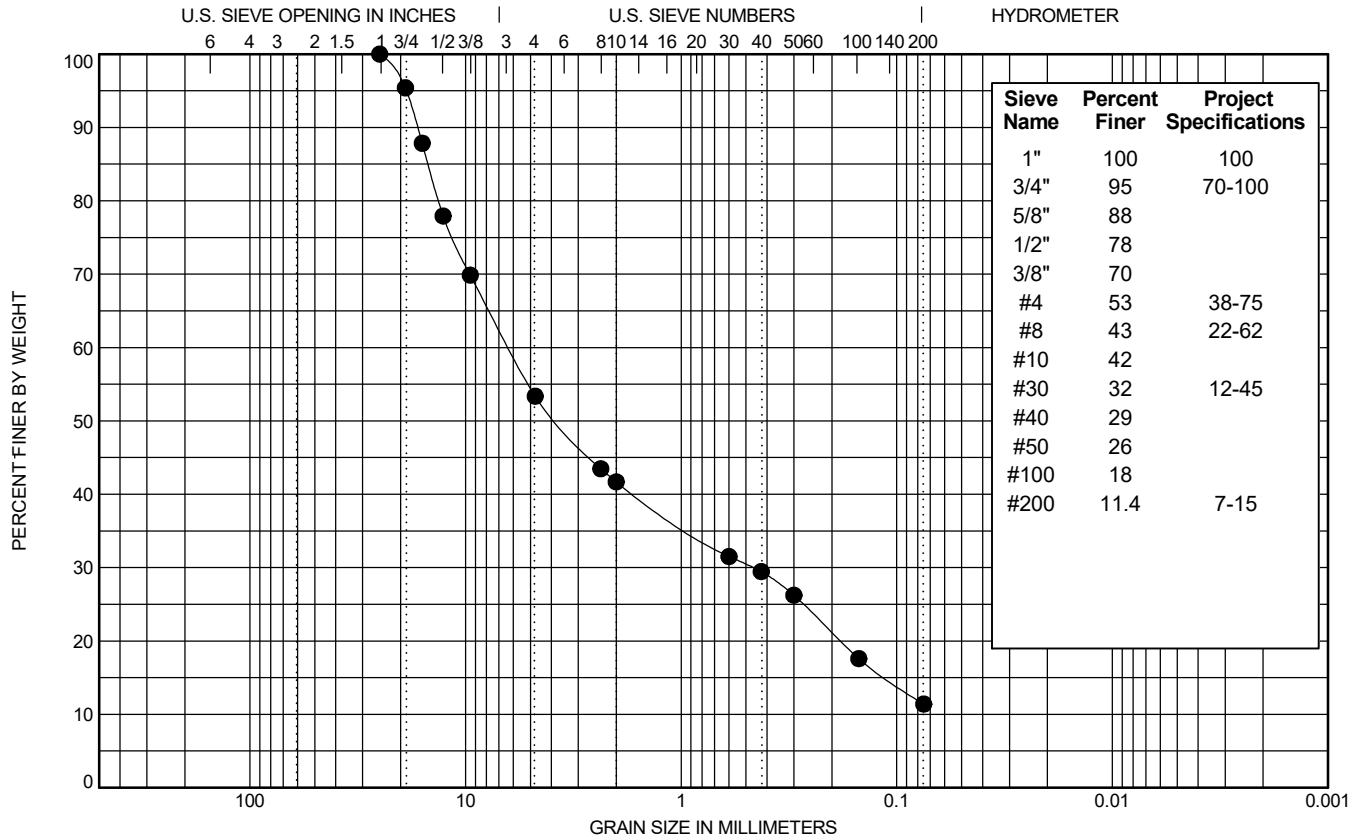
Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

Sample Number:	3	Date Sampled:	5/28/2020
Project Specifications:		Sampled By:	NTI
Aggregate Type:	NDDOT CLASS 13, AGGREGATE BASE, FROM KNIFE RIVER		
Location Sampled:	HAUL ROAD AGGREGATE BASE AT STATION 92+00		

Sample Data

Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
0.54	97.86	25	6.279	0.466		46.6	42.0	11.4	



Sieve Name	Percent Finer	Project Specifications
1"	100	100
3/4"	95	70-100
5/8"	88	
1/2"	78	
3/8"	70	
#4	53	38-75
#8	43	22-62
#10	42	
#30	32	12-45
#40	29	
#50	26	
#100	18	
#200	11.4	7-15

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(6/5/20)

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GRAIN SIZE DISTRIBUTION

ASTM C136 & D422

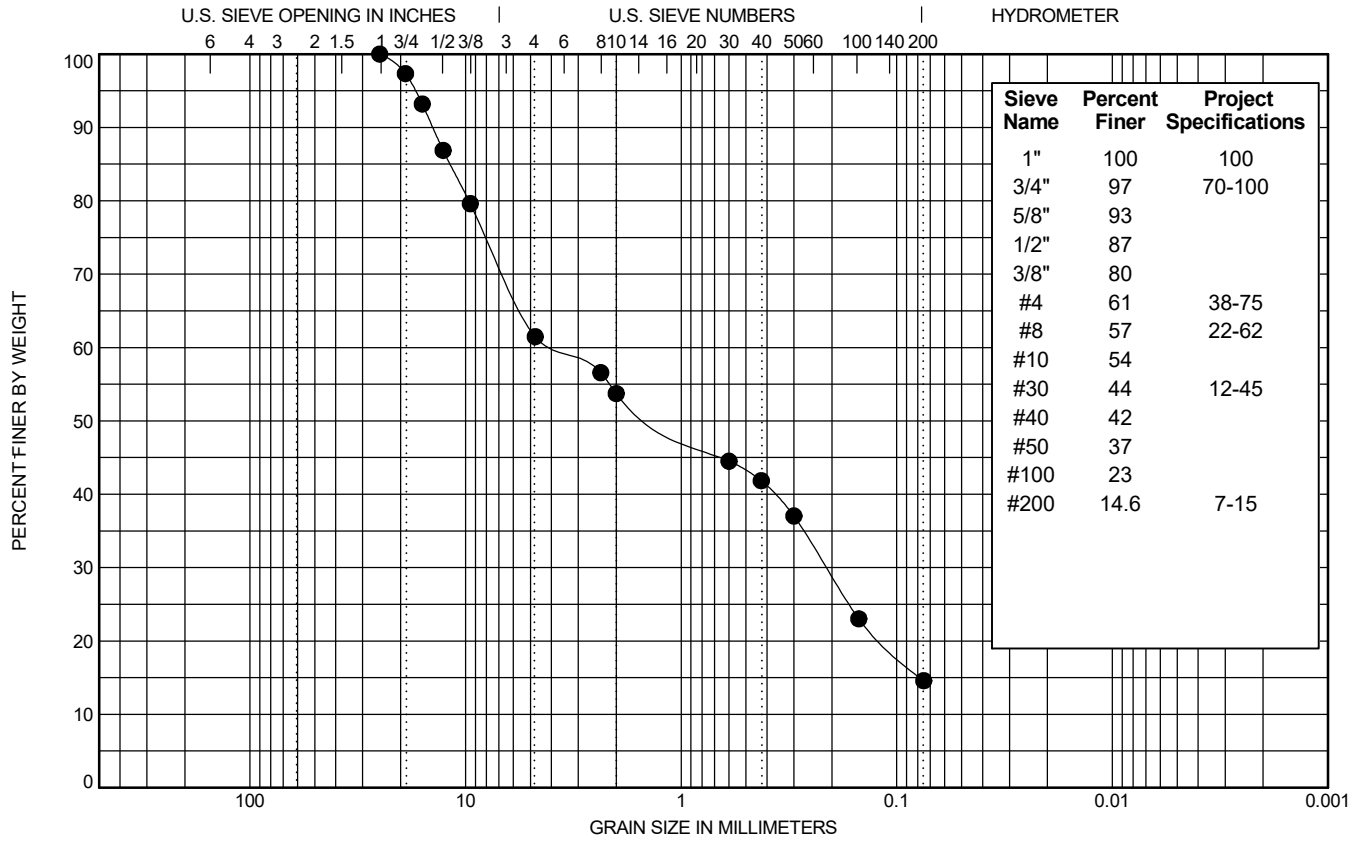
Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

Sample Number:	4	Date Sampled:	5/29/2020
Project Specifications:	NDDOT CLASS 13	Sampled By:	NTI
Aggregate Type:	NDDOT CLASS 13; AGGREGATE BASE FROM KNIFE RIVER		
Location Sampled:	HAUL ROAD AGGREGATE BASE AT STATION 113+50		

Sample Data

Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
		25	3.848	0.212		38.5	46.9	14.6	



Sieve Name	Percent Finer	Project Specifications
1"	100	100
3/4"	97	70-100
5/8"	93	
1/2"	87	
3/8"	80	
#4	61	38-75
#8	57	22-62
#10	54	
#30	44	12-45
#40	42	
#50	37	
#100	23	
#200	14.6	7-15

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(6/10/20)

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GRAIN SIZE DISTRIBUTION

ASTM C136 & D422

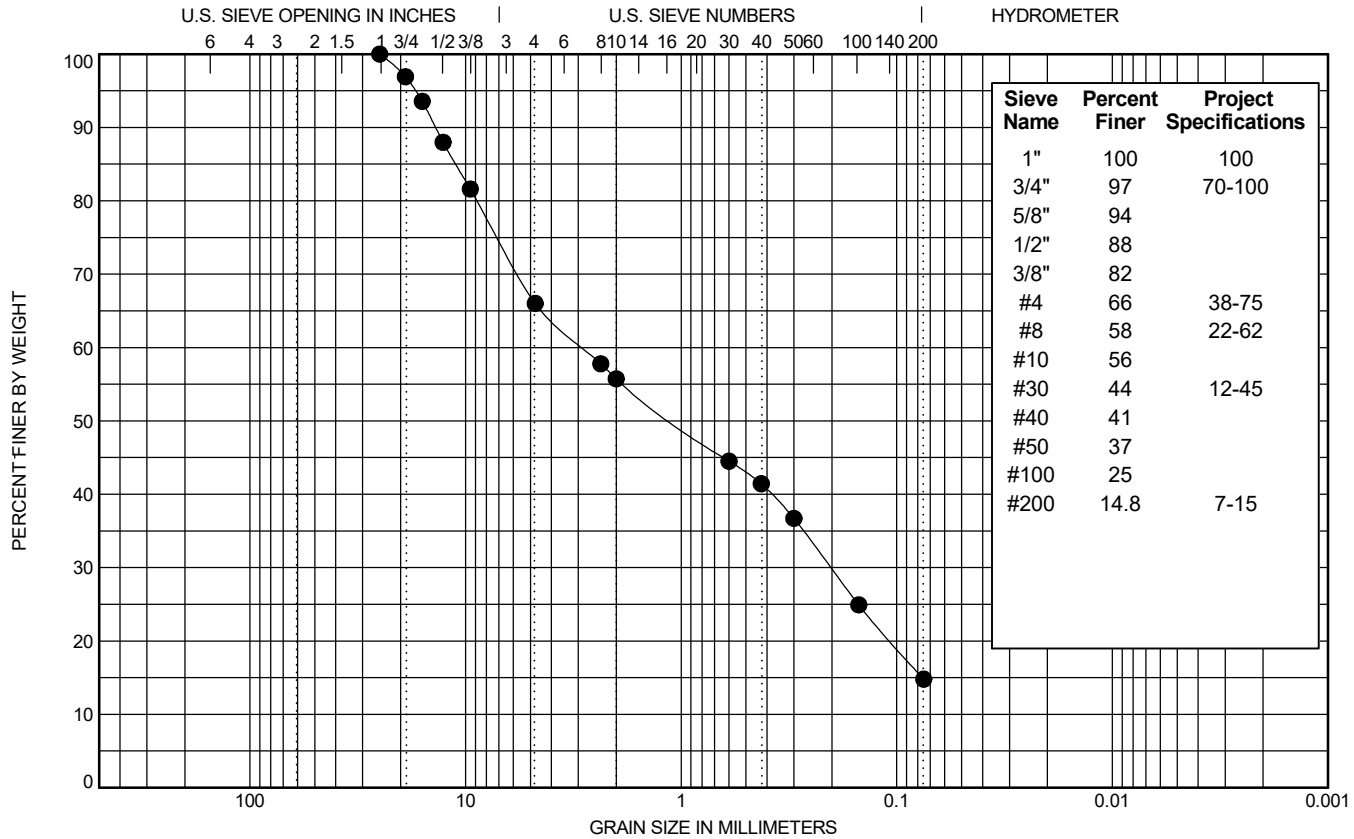
Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

Sample Number:	5	Date Sampled:	6/1/2020
Project Specifications:	NDDOT CLASS 13	Sampled By:	NTI
Aggregate Type:	NDDOT CLASS 13, AGGREGATE BASE FROM KNIFE RIVER		
Location Sampled:	HAUL ROAD AGGREGATE BASE AT STATION 15+00		

Sample Data

Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
		25	2.85	0.202		34.0	51.2	14.8	



Sieve Name	Percent Finer	Project Specifications
1"	100	100
3/4"	97	70-100
5/8"	94	
1/2"	88	
3/8"	82	
#4	66	38-75
#8	58	22-62
#10	56	
#30	44	12-45
#40	41	
#50	37	
#100	25	
#200	14.8	7-15

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(6/12/20)

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GRAIN SIZE DISTRIBUTION

ASTM C136 & D422

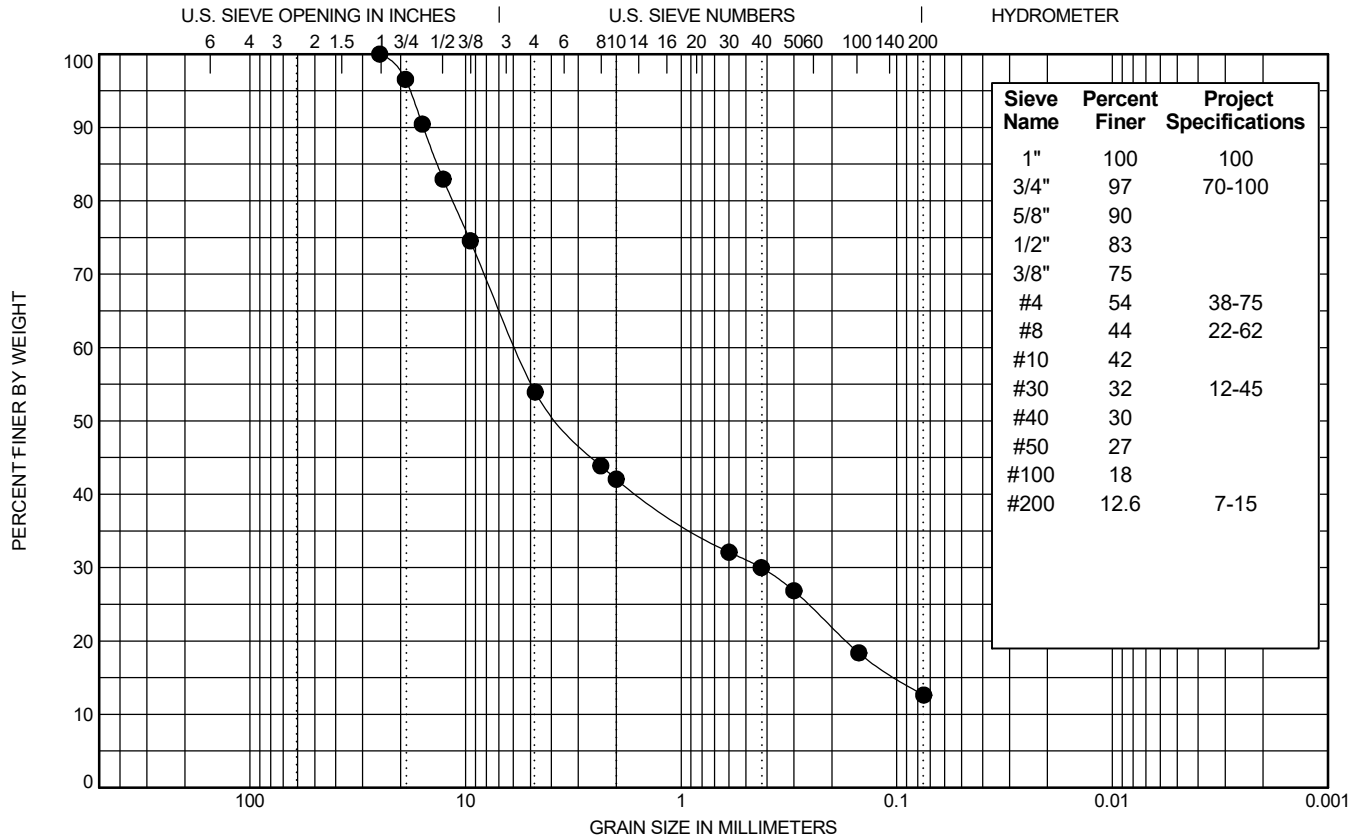
Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

Sample Number:	6	Date Sampled:	6/2/2020
Project Specifications:	NDDOT CLASS 13	Sampled By:	NTI
Aggregate Type:	NDDOT CLASS 13, AGGREGATE BASE FROM KNIFE RIVER		
Location Sampled:	HAUL ROAD AGGREGATE BASE AT STATION 129+00		

Sample Data

Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
		25	5.826	0.426		46.1	41.3	12.6	



Sieve Name	Percent Finer	Project Specifications
1"	100	100
3/4"	97	70-100
5/8"	90	
1/2"	83	
3/8"	75	
#4	54	38-75
#8	44	22-62
#10	42	
#30	32	12-45
#40	30	
#50	27	
#100	18	
#200	12.6	7-15

Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(6/12/20)

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

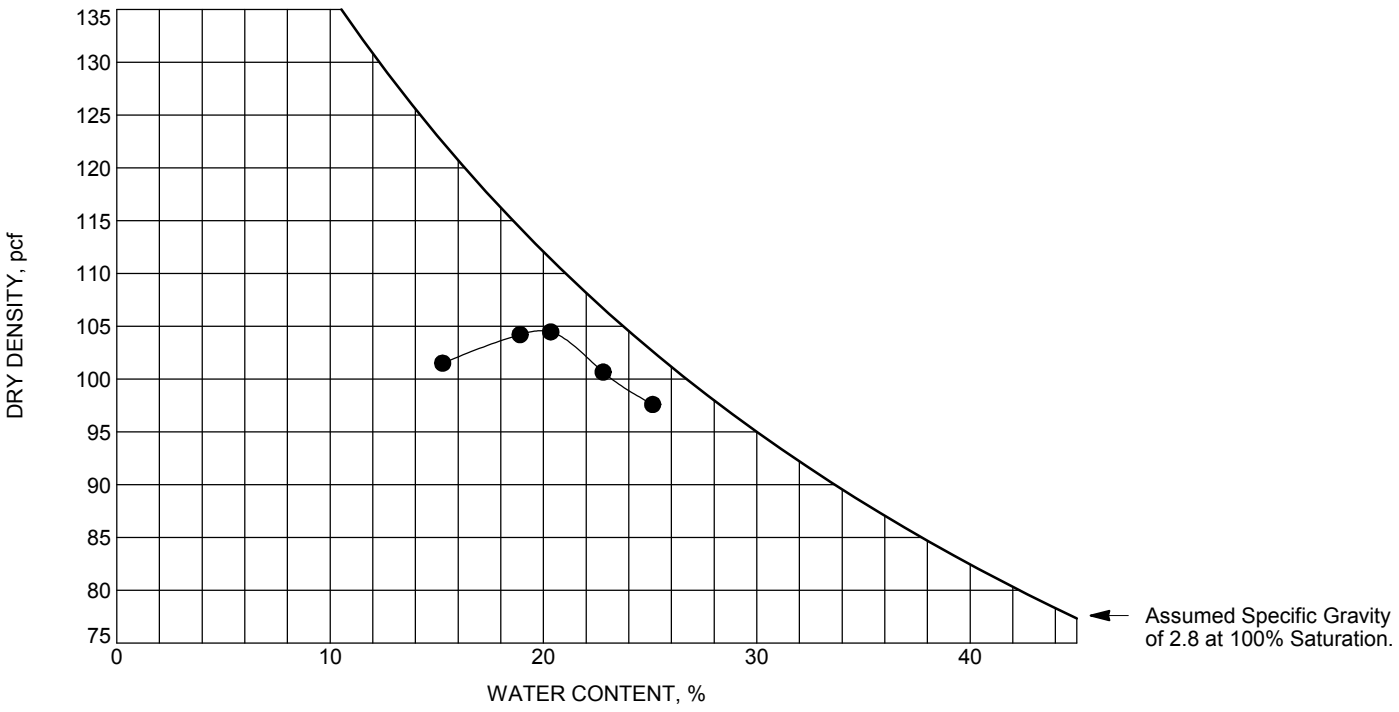
Sample Number:	P-1	Date Sampled:	3/31/2020
Location Sampled:	CELL #1 - SOUTH		
Soil Type:	SANDY FAT CLAY, BROWN (CH)		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	104.6 pcf	MC% As Received:	
Optimum Water Content:	19.9 %		



Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/6/20)

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

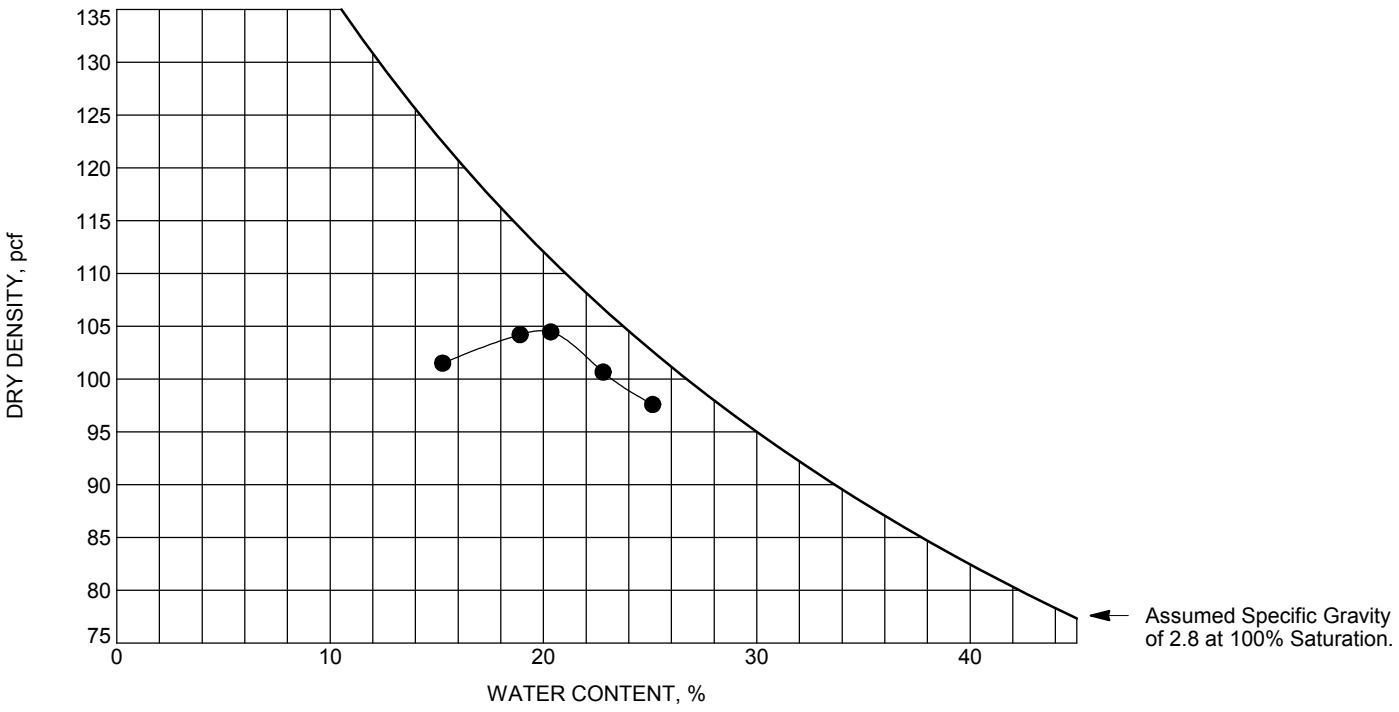
Sample Number:	P-1	Date Sampled:	3/31/2020
Location Sampled:	CELL #1 - SOUTH		
Soil Type:	SANDY FAT CLAY, BROWN (CH)		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	104.6 pcf	MC% As Received:	
Optimum Water Content:	19.9 %		



Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/6/20)

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

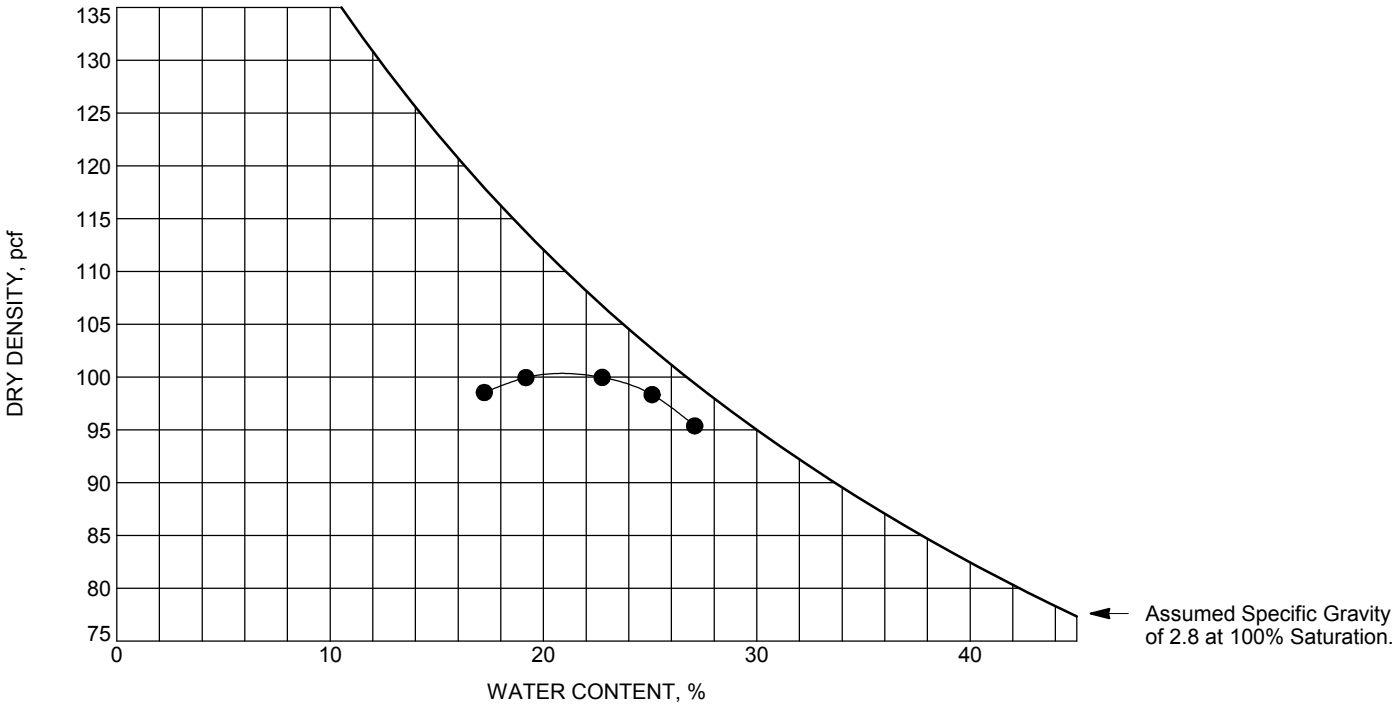
Sample Number:	P-2	Date Sampled:	3/31/2020
Location Sampled:	CELL #1 - MIDDLE		
Soil Type:	SANDY LEAN CLAY, (CL) LIGHT BROWN TO GRAY		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	100.4 pcf	MC% As Received:	
Optimum Water Content:	20.9 %		



Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/6/20)

NTI NORTHERN TECHNOLOGIES, LLC

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

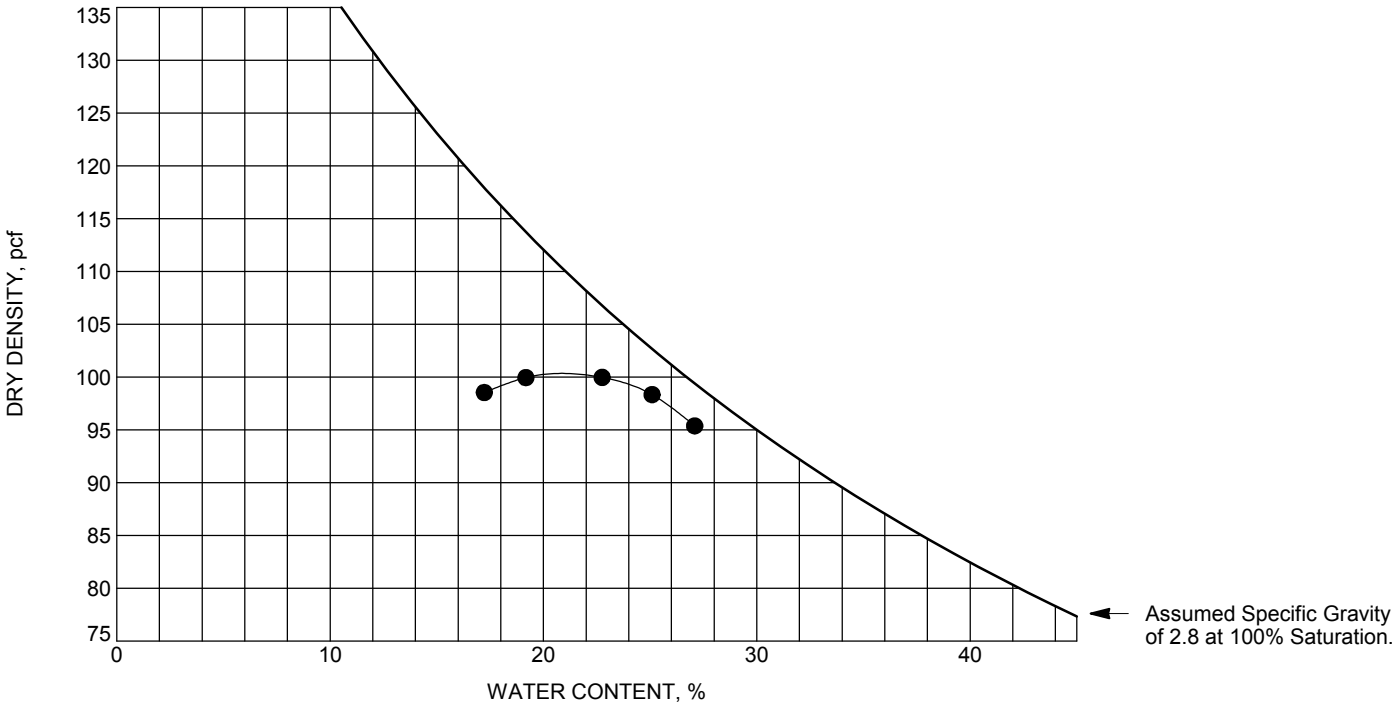
Sample Number:	P-2	Date Sampled:	3/31/2020
Location Sampled:	CELL #1 - MIDDLE		
Soil Type:	SANDY LEAN CLAY, (CL) LIGHT BROWN TO GRAY		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	100.4 pcf	MC% As Received:	
Optimum Water Content:	20.9 %		



Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/6/20)

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

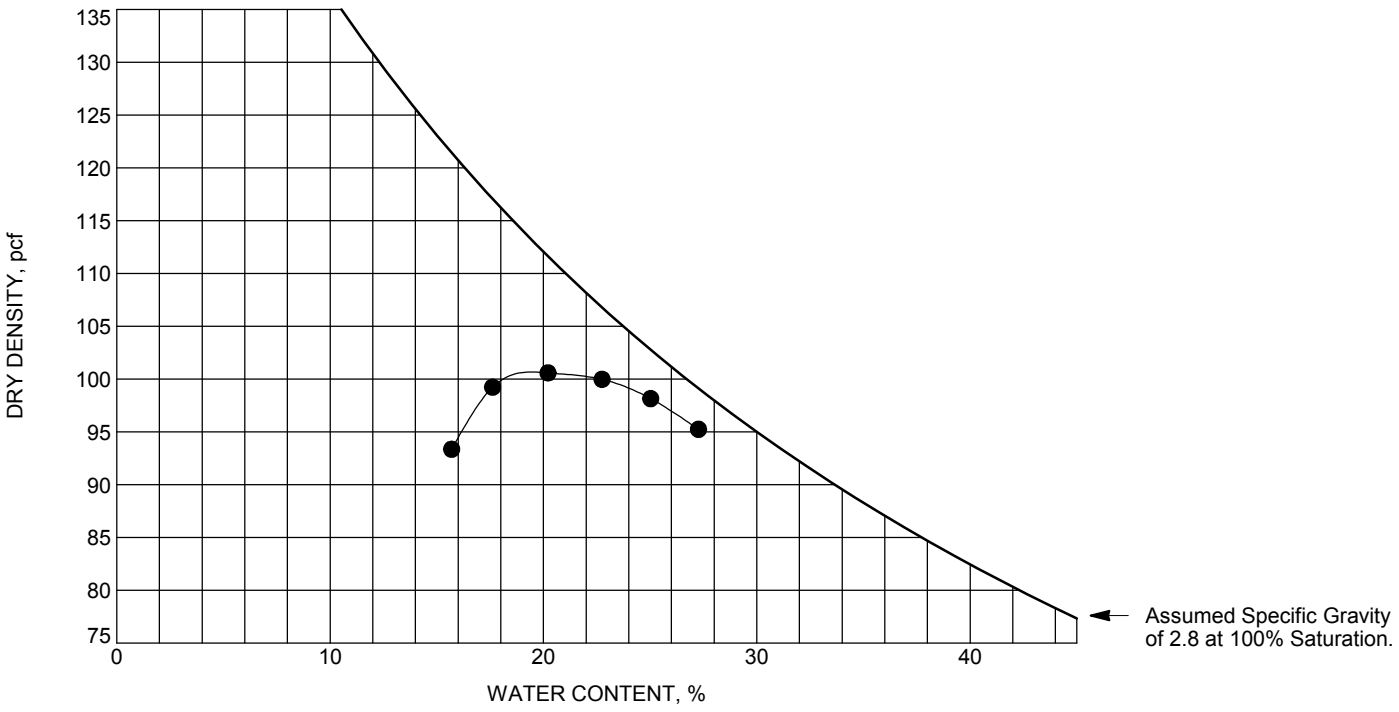
Sample Number:	P-3	Date Sampled:	4/8/2020
Location Sampled:	CELL #1 - MIDDLE #2		
Soil Type:	SANDY FAT CLAY, LIGHT BROWN TO GRAY		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	100.7 pcf	MC% As Received:	
Optimum Water Content:	19.4 %		



Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/21/20)

NTI NORTHERN TECHNOLOGIES, LLC

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

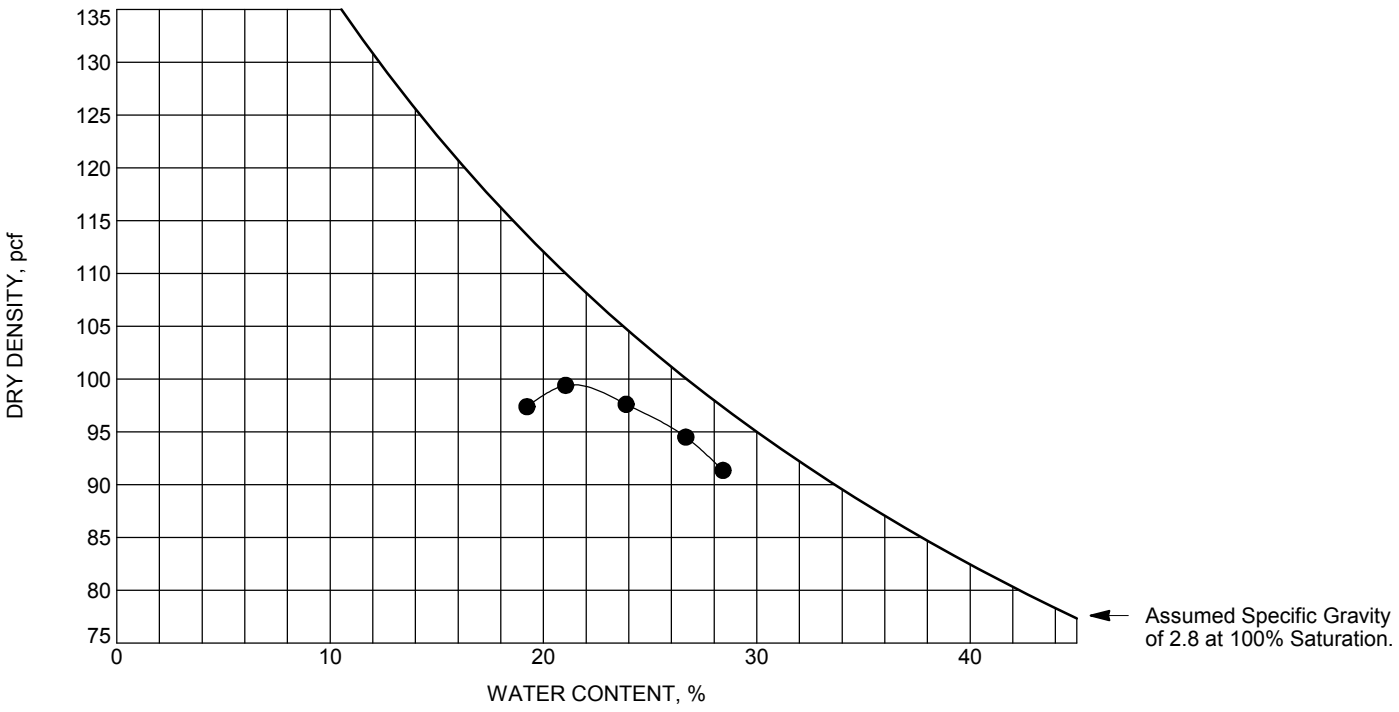
Sample Number:	P-4	Date Sampled:	4/8/2020
Location Sampled:	CELL #1, CENTER OF NORTH HAUL ROAD		
Soil Type:	SANDY FAT CLAY, BROWN		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	99.5 pcf	MC% As Received:	
Optimum Water Content:	21.3 %		



Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(4/21/20)

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Bismarck, North Dakota 58504
P: 701.425.5791 F: 701.232.1864
www.NTIgeo.com

LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

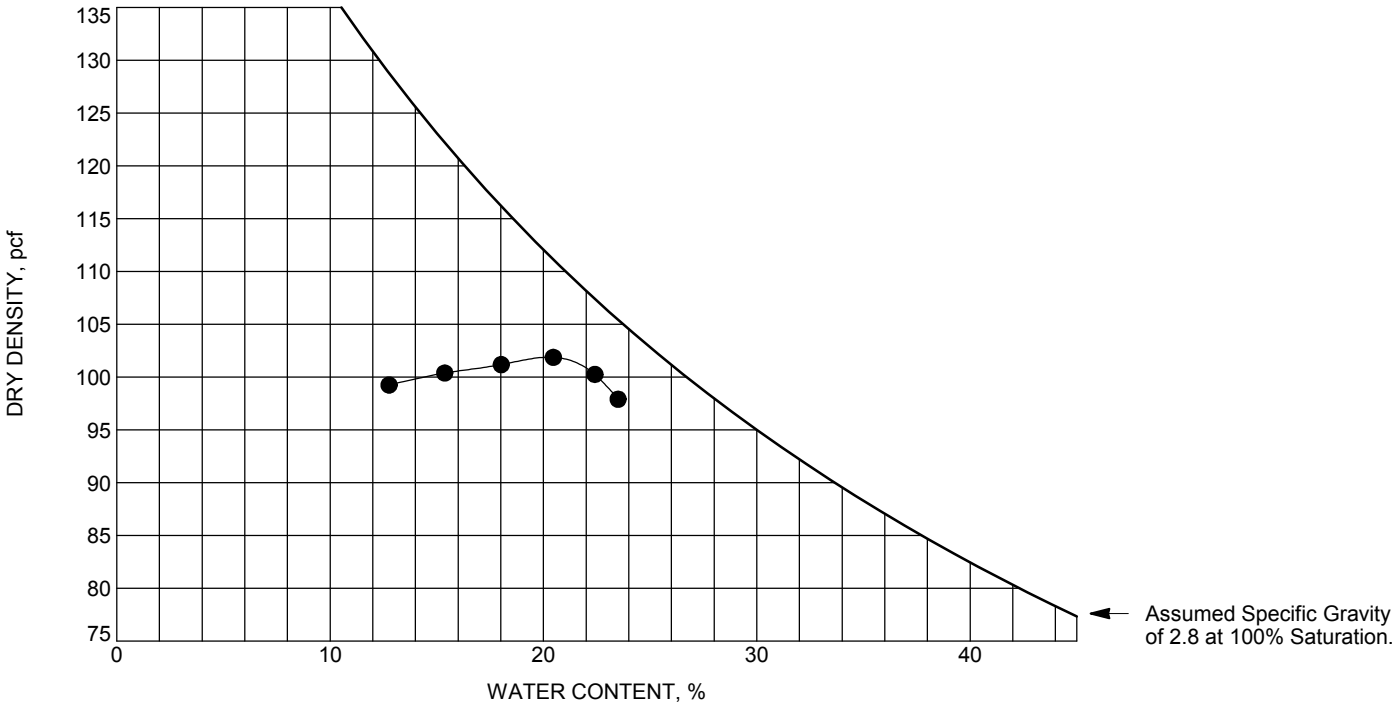
Sample Number:	P-5	Date Sampled:	4/15/2020
Location Sampled:	MIDDLE #3 (NORTH) OF CELL #1		
Soil Type:	SANDY FAT CLAY, LIGHT BROWN TO GRAY		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	101.9 pcf	MC% As Received:	
Optimum Water Content:	20.2 %		



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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project:	Solid Waste Management Area Cell 1
		Project Number:	20.BIS09947.000
		Location:	Bismarck Landfill Bismarck, ND
Attention:	Zach Bopp, PM		

Sample Information

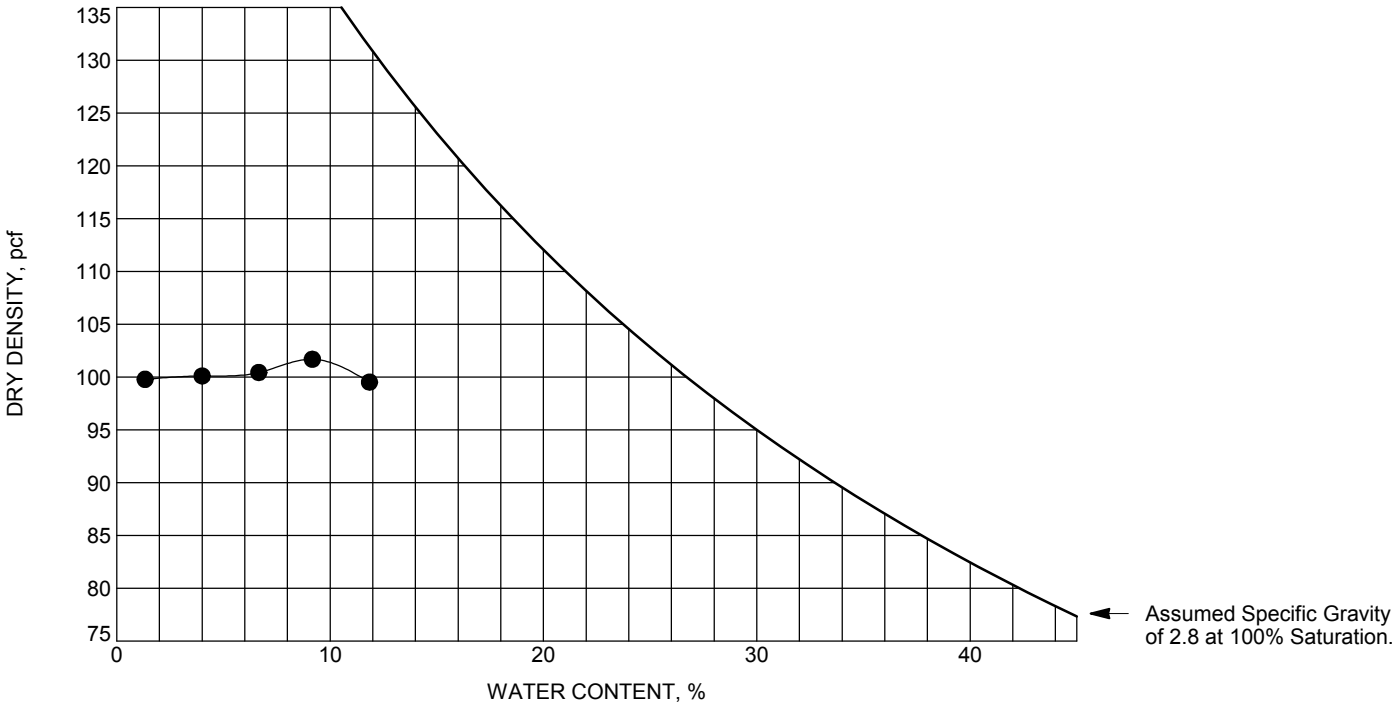
Sample Number:	P-6	Date Sampled:	4/15/2020
Location Sampled:	EXISTING SAND MATERIAL ON SITE (SEE ALSO MA-1 GRADATION)		
Soil Type:	SAND, FINE GRAINED (SP), LIGHT BROWN		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Wet		

Sample Data

Maximum Dry Density:	101.7 pcf	MC% As Received:	
Optimum Water Content:	9.2 %		



Comments:

Cc:

Submitted by,
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(4/30/20)

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

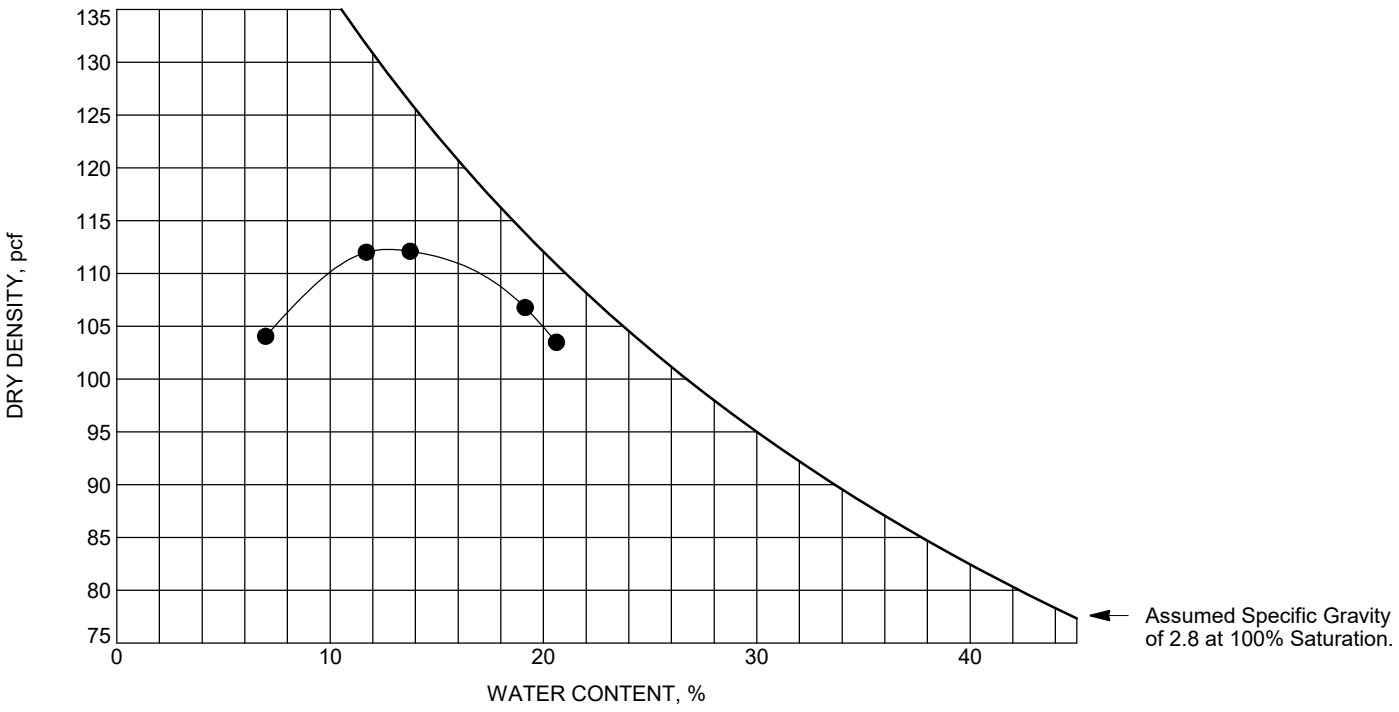
Sample Number:	p-7	Date Sampled:	5/18/2020
Location Sampled:	CELL #1 BOTTOM; WEST END		
Soil Type:	SANDY LEAN CLAY, GRAY		

Laboratory Information

Test Method:	ASTM D1557 Method A	Rammer Type:	Manual
Preparation Method:	Dry		

Sample Data

Maximum Dry Density:	112.3 pcf	MC% As Received:	19.5
Optimum Water Content:	12.7 %		



Comments:

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Report To:	RJ Zavoral and Sons 1706 Bygland Rd SE East Grand Forks MN 56721	Project: Project Number: Location:	Solid Waste Management Area Cell 1 20.BIS09947.000 Bismarck Landfill
Attention:	Zach Bopp, PM		Bismarck, ND

Sample Information

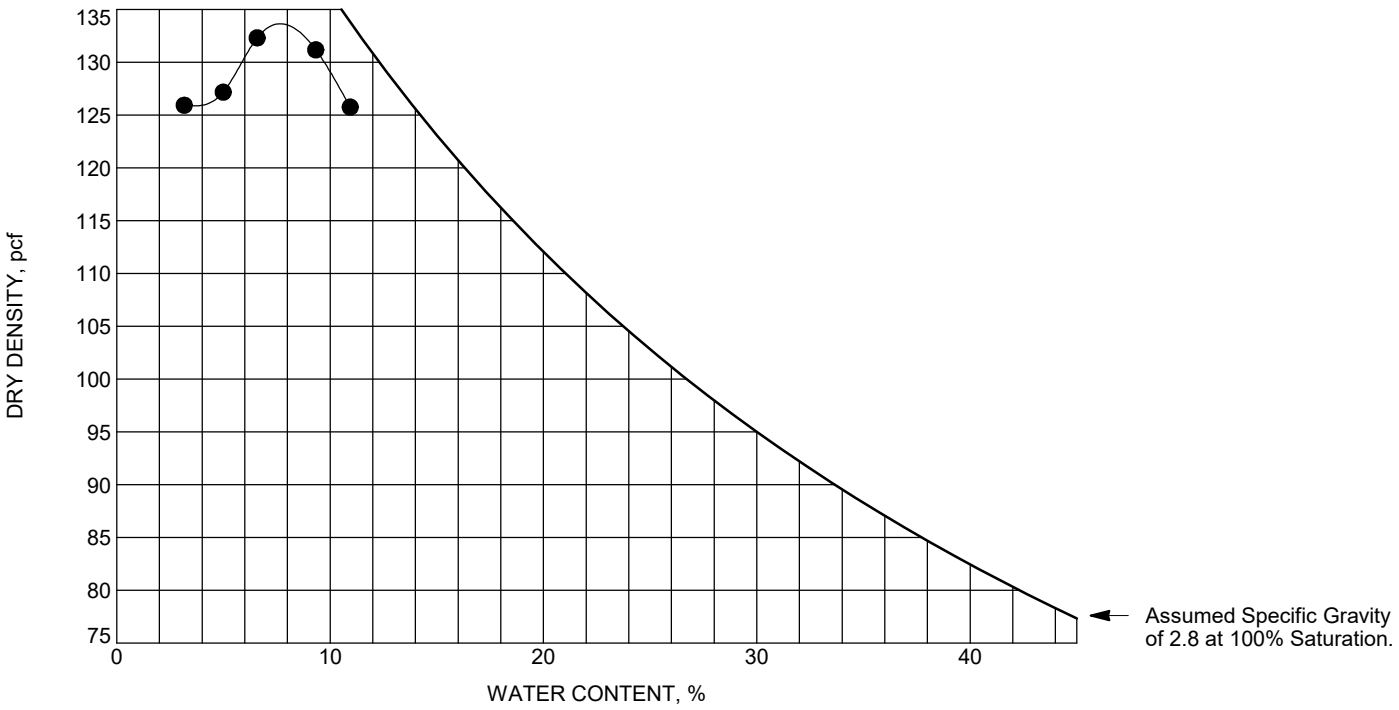
Sample Number:	P-8	Date Sampled:	5/20/2020
Location Sampled:	NDDOT CLASS 13 AGGREGATE BASE FROM SOURCE KNIFE RIVER		
Soil Type:	NDDOT CLASS 13 AGGREGATE BASE		

Laboratory Information

Test Method:	ASTM D1557 Method B	Rammer Type:	Manual
Preparation Method:	Wet		

Sample Data

Maximum Dry Density:	133.6 pcf	MC% As Received:	
Optimum Water Content:	7.6 %		



Comments:

Cc:

Submitted by,
Northern Technologies, LLC

Tyler Hall
(6/5/20)

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Project: Bismarck Cell 1 Construction - LF 2021-001 (Solicitation Support)

Date: _____ Company: _____

Signature: _____

Its: _____

SPECIAL PROVISION NO 35
Geotextile Fabric

PART 1 – GENERAL

SUMMARY
This section covers the work necessary to furnish and install geotextile fabric materials.

MEASUREMENT AND PAYMENT
Measurement: Work specified in this section will be measured based upon plan area in square yard (SY) of the proposed limits (pay limits) of the geotextile fabric as shown in the Contract Drawings, taken as a 3-dimensional projected area.

Payment: Payment for this includes, but is not limited to, the following Work:

- Furnishing and installing geotextile fabric as shown in the Contract Documents
- Preparation of surfaces in preparation for geotextile placement
- All seaming operations to join panels, if applicable.
- Protect of geotextile fabric materials during placement and backfilling operations as indicated in the Contract documents

SUBMITTALS
Submit Manufacturer's Certification for the geotextile fabric materials indicating that the materials meet the physical requirements stated in Part 2 of this specification section.

DELIVERY, STORAGE, AND HANDLING
Geotextile will be protected from precipitation, inundation, ultraviolet exposure, dirt puncture, cutting, and other damaging or deleterious condition.

PART 2 - PRODUCTS

GENERAL
CONTRACTOR will furnish materials whose “Minimum Average Roll Values”, as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria listed in this section.

Nonwoven geotextile products will be comprised of polymeric yarns of fibers oriented into a stable network, which retains its relative structure during handling, placement, and long-term service.

EQUIPMENT
CONTRACTOR will furnish all necessary equipment required to accomplish the installation of the

MATERIALS

The geotextile fabric will be a nonwoven polypropylene or polyester geotextile, supplied by the Geosynthetics Contractor, which meets the requirements of **TABLE 1** below. The geotextile shall be TenCate Mirafi S1600 or approved equal.

GEOTEXTILE SEAMING

Geotextile seams will be thermally seamed or sewn with polymeric thread. The thread will be capable of supplying a seam strength efficiency of 80 percent of the required tensile strength utilizing a Type 401 two-thread chain stitch with a "J" seam. Cushion geotextile seams will be thermally bonded at all overlaps.

PART 3 EXECUTION

GENERAL INSTALLATION REQUIREMENTS

All geotextiles will be deployed in accordance with the manufacturer's recommendations, standards, and guidelines.

Geotextile procurement, transportation, storage, handling and installation will be the responsibility of the CONTRACTOR. Any damaged or unacceptable material will be replaced at the sole expense of the CONTRACTOR. During shipment and storage, the geotextile will be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. To that effect, geotextile rolls will be shipped and stored in relatively opaque and watertight wrappings.

Geotextile rolls will be handled in such a way that they are not damaged.

Geotextile will be securely anchored and then deployed in such a manner as to continually keep the geotextile sheet in sufficient tension to preclude folding or wrinkling.

Geotextile will be weighted with sandbags or the equivalent to prevent movement caused by wind. Such sandbags will be installed during placement and will remain until replaced with cover material.

CONTRACTOR will take any necessary precautions to prevent damage to underlying materials during placement of the geotextile.

During placement of geotextile, care will be taken not to entrap in the geotextile, stones, excessive dirt, or moisture that could damage the geomembrane or hamper subsequent seaming.

Geotextile will not be exposed to precipitation prior to being installed. Wrappings protecting geotextile rolls will be removed less than one hour prior to unrolling the geotextile. After the wrapping has been removed, the geotextile will not be exposed to direct sunlight for more than 15 days.

CONTRACTOR will pay particular attention at seams such that no earth cover material is inadvertently inserted beneath the geotextile.

All sewing will be done using polymeric thread with properties equal to or exceeding those of the geotextile.

CONTRACTOR will place all cover materials in such a manner such that the geotextile is not damaged, minimal slippage of the geotextile or underlying layers occurs, and no excess tensile stresses are present in the geotextile.

Soil will be placed over the geotextile by "rolling" (not dragging) a minimum of 12 inches of material ahead of all construction equipment.

On slopes steeper than 6H:1V, cover material will be placed from the bottom of the slope proceeding upward.

No construction equipment with average ground pressure greater than 8 psi will operate on slopes unless they are more than 10 feet from exposed geotextiles and are operating on 2 feet or more of cover material thickness.

Operation of equipment over geotextile will be in conformance with the following guidelines:

Average Equipment Ground Pressure (psi)	Minimum Lift thickness Under Tracks (in)
5	12
5-8	24
>8	36

SEAMING OF GEOTEXTILE

On slopes flatter than or equal to 10H:1V, adjacent cushion geotextile panels may be sewn, or heat bonded. All seaming, heat bonding or overlapping of sheets will be done in accordance with the manufacturer's recommendations. For overlapped seams that are thermally bonded, overlap distances will be a minimum of 6 inches.

n slopes greater than 10H:1V, adjacent panels will be sewn or heat bonded. All seams on such slopes will be oriented parallel to (in the direction of) the slope.

Sewn seams will use a Type 401 stitch. One or two rows of stitching may be used.

Seams may be heat bonded using thermal fusion or ultrasonic devices.

Adjacent panels will be overlapped a minimum of 6 inches prior to seaming.

Care will be taken not to introduce soil to the collection system drainage layer stone during backfilling operations

REPAIRS

Holes or tears in the fabric will be repaired as follows: A fabric patch made from the same geotextile will be thermally welded into place. Provide a minimum overlap of 12 inches in all directions. Should any tear exceed 10 percent of the width of the roll, that roll will be removed from the slope and replaced.

Care will be taken to remove any soil or other materials that may have penetrated the torn geotextile.

Log any defects, holes, and tears that are identified and repaired.

TESTING

Manufacturer conformance/manufacturer testing, prior to construction, of all geotextile materials is the responsibility of the CONTRACTOR. Results of the conformance/manufacturer testing are to be submitted to the ENGINEER for approval prior to delivery and acceptance of the material for use in the project. Field quality assurance activities will be performed in accordance with the Construction Quality Assurance Manual and will include visual field inspection by the ENGINEER.

PROTECTION

Geotextiles will be stored in such a manner to protect them from puncture, dirt, grease, water, mud, or excessive heat.

TABLE 1

MINIMUM REQUIRED PROPERTIES

CUSHION GEOTEXTILE

(NONWOVEN POLYPROPYLENE OR POLYESTER)

PROPERTIES AND REQUIREMENTS	QUALIFIER	UNITS	SPECIFIED VALUES(1)	TEST METHOD
Fabric Mass Per Unit Area	Minimum(1)	oz/sy	16	ASTM D 5261
Grab Tensile Strength (2)	Minimum(1)	lbf	425	ASTM D4632
Grab Tensile Elongation (2)	Minimum(1)	%	50	ASTM D 4632
CBR Puncture Strength	Minimum(1)	lbf	1200	ASTM D 6241
UV Resistance (3) (4)	Minimum(1)	%	80	ASTM D 4355
Trapezoidal Tear Strength	Minimum	lb	155	ASTM D 4533

Notes:

(1) All values represent minimum average roll values [MARVs} (i.e., any roll in a lot should meet or exceed the values in this table).

(2) Minimum value measured in either direction.

(3) Ultraviolet resistance requirement is at 500 hours of exposure.

(4) Manufacturer to provide factory certification